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FACTORY

MANAGEMENT AND MAINTENANCE

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A McGRAW-HILL PUBLICATION

OCTOBER 1941

REVOLT IN THE CIO

PAGE 50

USE THIS GREAT FUND OF PLASTICS EXPERIENCE

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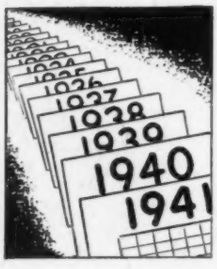
UTILIZE KNOWLEDGE AND EXPERIENCE OF BAKELITE PLASTICS HEADQUARTERS
BASED ON MANY YEARS' CO-OPERATION WITH INDUSTRY AND GOVERNMENT



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PLASTICS HEADQUARTERS

FACTORY
MANAGEMENT AND MAINTENANCE
A McGRAW-HILL PUBLICATION
OCTOBER 1941

REVOLT IN THE CIO PAGE 50

In the airplane view of Lensdale, American Optical Company's big lens-grinding plant at Southbridge, Mass., the color camera has caught something of the red and green and gold glory of a New England autumn. Here millions of ophthalmic lenses are ground annually for use in prescription glasses, sun glasses, industrial safety goggles, and aviation goggles, also such essential national defense equipment as instruments for the diagnosis and correction of vision, and (at Spencer Lens Company, Buffalo) military fire control instruments.

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MANAGEMENT AND MAINTENANCE

OCTOBER · 1941

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"SURE I WANT MORE TONNAGE," HE TOLD ME*

*THE REX MAN

" . . . BUT I DON'T WANT HIGHER COSTS!"

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FACTORY
MANAGEMENT AND MAINTENANCE
L · C · MORROW · EDITOR

The Materials Problem Calls for Full Cooperation by Industry

WE NEED honest-to-God planning and scheduling in the Washington end of defense. And it looks as though we are going to get it. In the biggest management job ever undertaken, at last there is to be a survey of supply needs, followed by allocation of available materials to fill those needs.

The SPAB (Supply Priorities and Allocations Board) will do the job. A most likely result will be almost complete substitution of allocations for the present cumbersome priorities. Which is to say that, instead of handing out preference ratings, materials actually will be parceled out in sequence and amount determined by the Board.

It is estimated by reliable authority that about three months will be required to find out how extensive are the inventories of materials being held by industry, the Army, and the Navy; and to pair off consumption of materials with their production. When that is done, defense will have first call, as it does now. But whereas now the amounts of materials going to non-defense industries are becoming less and less, because of fear that there may not be enough for defense, the balancing of consumption against production is likely to result in more for non-defense.

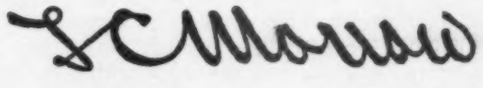
One thing is sure. Until excessive inventories (reported reliably to exist) are either used up or redistributed, the uncertainty of the availability of materials for non-defense will continue, and unemployment in non-defense industries will increase.

It is not going to be easy for SPAB to say, specifically: "These are the amounts of materials we shall need during the coming month, for both defense and non-defense; these are the amounts that will be produced; these are the allocations." Eventually that will be done, but it will not be done effectively until the influence of hoarding has been overcome. It may be that surplus stocks will be taken from the Army, the Navy, and some manufacturers, and placed where they can be used immediately; but even that action cannot be taken extensively because of stocks of materials hidden by "goods-in-process" and other methods.

The present situation seems to net down to a need for everyone to put all the cards on the table. The Washington end of defense should be specific with its objectives; materials should be honestly reported wherever they exist; objectives should be paired off with materials, and schedules set up. It's just as Mr. Knudsen said, recently: "Our great need is for management that can plan. We must have labor's cooperation, but management, brains, and planning are what we need to do this job."

Mr. Knudsen was talking to industry, and I think he meant we need more good management in industry. If so, he's right. But also it's what we have been needing for a long time in Washington, and which it seems we are now on the verge of getting, through the medium of SPAB.

There's one thing we all must remember, though, and do something about: SPAB can't do it alone; it must have the full cooperation of industry, both defense and non-defense.



Revolt in the CIO

Striking against a union (UMW-CIO) dues increase, these mine workers gather at dawn in Nesquehoning, Pa., for picket duty. Front row, left to right: Eddie Kennedy, Nick Digiglio, Garrett Miller, Jack Cadden

22,000 mine workers, "little guys tired of being pushed around," defy John L. Lewis on dues check-off in an unprecedented strike

CHARLES B. COATES, Associate Editor, Factory

DOWN THE ANTHRACITE-LADEN Panther Creek Valley of Pennsylvania, on September 11, rolled one of the most portentous stormclouds in the history of organized labor. On that day there began a strike of coal mine employees *against their union*, the United Mine Workers (CIO)—a strike protesting an increase in union dues and assessments collected by the check-off system.

The walkout was completely unprecedented, a spontaneous mass uprising that was destined to involve over 20,000 rank-and-file workers. The men had no quarrel with their employers. Their dispute was solely with the huge international union of which John L. Lewis has long been chieftain. Significantly, the strikers not only stopped work without Lewis's permission, but also defied a union order to go back.

Why? Not because the men have turned against unionism as such, nor even because they are fighting the closed shop and check-off—although they don't like the latter—but *because they believe the union is taking their money away from them without their permission.* They contend that they authorized the deduction of only $14 a year from their pay for union dues and assessments (in accordance with the union's check-off agreement with the mine owners). When the union raised the check-off total to $24 a year, the trouble began.

The employers explained to the men that they were compelled under the union contract to deduct $10 more from their pay—$6 for the new international assessment and $4 for an increase in district dues. The union officers contended that the assessment had been approved by the men themselves in a national referendum. To this the men replied declaring that the referendum was unrepresentative.

"We agreed to pay the $14—and no more," the strike leaders asserted.

"We'll pay that any time. But we won't pay $24. If the union can take $10 away from us without our say-so today, it can take $50, $100, $1,000, or all we've got tomorrow."

The stormcloud was no larger than a man's hand when it first appeared over the big colliery in the little town of Nesquehoning, Pa. It was no bigger, in fact, than the muscular hand of one Garrett Miller, a hard-coal miner for 20 years.

Miller had been thinking, thinking hard. When the new union levies went into effect he went to his foreman, stuck out his hand, and said:

"I want my money back. It isn't the union's money—it's mine."

The foreman replied that the company could not violate its contract and was powerless to help him. Miller thought some more, talked it over with his friends, Eddie Kennedy, Nick Digiglio, Jack Cadden, Andy Rimsky, Mike Goral, and others. He told them he, for one, would pay no more —and they agreed.

A committee was formed, a petition was presented to the union officers, and an appeal was addressed directly to Lewis. Lewis made a noncommittal reply. Then the strike began. The 1,200 mine workers at Nesquehoning were the first to go out.

Strange New Strike

Mass meetings followed. Automobile picket parades roared over the winding Allegheny highways. The revolt quickly spread up and down the valley from Lansford through Nesquehoning to Hazleton and beyond. Soon, 22,000 mine workers, all the members of District No. 7, UMW, were actively engaged in this strange new kind of strike.

In vain the local and district union officers pleaded with the strikers, threatened to suspend them from the union, then did. The strikers retaliated by "expelling" the officers. One day a mysterious barricade rose on the highway outside Hazleton in the path of an oncoming picket parade. Police removed the obstruction just in time to avert disaster.

Within a week of the strike's start, the district was in the grip of a tension such as it has seldom known. That's saying something, for the streets of Hazleton, the anthracite area's key city, have been wet with the blood of strike rioters in the past.

"It's a miracle that there hasn't been real violence this time—except for a number of fist fights, and we don't count them," said a local newspaperman. "But if the strike goes on, God knows what will happen."

"I don't blame the strikers," said a Hazleton merchant. "Business has come to a standstill here, but I hope they win."

"Seems to me they're just tired of the whole John L. Lewis organization," observed a garage mechanic. "The only mine leader that was ever any good was John Mitchell [early head of the United Mine Workers]. When Mitchell used to come to Hazleton he slept in miners' homes because he was too poor to pay hotel bills. When John Lewis comes to town he rents a big hotel suite."

As the strike spread, it became evident that the strikers had Lewis in something of a spot. His prestige at the November national convention of CIO would be badly damaged if 22,000 of his own mine workers were still out striking against him. Especially so, if he hopes to recapture the titular leadership of CIO.

Union officials were cautious in their comments. The national weekly, *CIO News* made no mention of the uprising in its issue of September 22. Hugh V. Brown, president of District No. 7, UMW, termed the walkout a "family quarrel." Brown is apparently well liked personally in the district, but his efforts to make peace met with boos. Lewis, queried in Washington on September 16, declined comment except to say that "the boys seem to be taking a holiday." Nevertheless he sent an International Fact-Finding Commission to Hazleton to investigate. After some parley, Miller and his men declined to compromise and sent the Commission away without a settlement.

Family Quarrel, Indeed

Miller, by then, had a new card to play. Nearby District No. 9, in the Southern anthracite region, warned the International that it, too, would join the strike unless somebody in high authority gave it a good explanation of the extra assessments. District 9 comprises 26,000 mine workers which, added to No. 7's 22,000, would make a big family quarrel indeed. New implications loomed. Should the revolt spread still further, it might cost the Mine Workers International hundreds of thousands of dollars a year! Should it spread to the auto workers, the steel workers, the printers, the hodcarriers, the teamsters, and so forth, it might cost CIO and AFL *millions* of dollars a year!

These developments have thrust Garrett Miller and his rough-hewn little committee into sudden prominence. Few men in the labor movement have stood up to the power of

A picketing parade roars through the Alleghenies to call out more mine workers in unprecedented uprising against check-off collection of union dues. Strike is not against employers but against John L. Lewis coal union

John L. Lewis as they have; no one has ever rallied such a revolt against a leadership so well entrenched.

Who are these strike leaders? What are their motives? To District President Brown they are "insurgents"—a dreadful term of abuse in United Mine Workers circles. To visiting newspapermen, they seem to be many things. By some reporters they have been depicted primarily as leaders of a protest against Lewis's political activities, his isolationism, and his opposition to President Roosevelt.

A face-to-face talk with the men themselves warrants no such grandiose interpretation. Go down to Nesquehoning, a typical little mining town straggling along the banks of Panther Creek, its shabby greys and browns a contrast to the colorful cliffs at its rim. Go there to a plain little miners' restaurant—just a restaurant, mind you, not a saloon—and meet Miller and some of his men. But go warily and under local auspices. Striking miners are often leery of the press, which sometimes leads to smashed cameras and broken heads.

Just Little Guys

In this case Miller and his companions have had good cause for caution. They cannot be sure whether a stranger has come to take a picture—or to bomb their homes. Once acquainted, however, they are eager to state their case.

"Get this straight," says Miller. "We are just little guys who are tired of being pushed around. Sure we're sick of Lewis's politics. But the big point is this: The union is trying to take money away from us that don't belong to it. We claim it's illegal and un-American, that's all."

Miller, a strongly built man of middle stature, talks vigorously but moderately, seldom raising his voice, yet there is a quiet determination about him. He is a graduate of Nesquehoning High School, taught school for two years, then became a machinist and finally a miner. In his home at 2 Rhume Street he carves jewelry out of hard coal as a hobby and makes rings out of mine crystals.

Hard-muscled little Nick Digiglio, at his elbow, shares Miller's burning sincerity, but displays it more excitably. He interrupts to exclaim:

"If they was to ask us to pay, it would be different! Hell, in the past we've paid two, three times as much for assessments in a single year—but we paid it, it wasn't taken out of our pay before we saw it."

"There's $4,000,000 in the International treasury, yet they slap on this

Unaware of the significance of their stand are miners who struck against union check-off levy. Above, Garrett Miller and Nick Digiglio

new assessment," Miller resumes. "So that costs us $6 a year. Then they raise our district dues $4 a year, 50 cents a month more than the other districts around here.

"We know a lot of our money is being wasted. We can see it with our own eyes. They promised us economy in the district office—and what happened? They used to employ five men in the Hazleton office and now they got 26 on the payroll!"

The strike leaders admit readily that they signed a power of attorney to their employers, authorizing deduction of the $14, when the check-off went into effect in 1936. Whether the union can collect more under the same agreement is, to them, at most an open legal question.

"All it says on the paper is $14," Miller asserts, "and I made up my mind then that that was all I was ever going to pay."

"We've got no high-priced lawyers, no fancy talkers, no political pull, no money," Digiglio rejoins. "All we got is our rights."

"One lawyer promised to get us an injunction," Miller adds, "but later he said the only way to do it was to file individual suits for every man. But we did get a letter from the Attorney General's office in Harrisburg that leads me to believe, if we could just get a good lawyer, we'd get somewhere."

Miller and his aides insist they have no desire to leave the union.

"Understand, we've always believed in the union because we thought the union was for labor and that's what we're for," Miller continues. "But it seems to us as if the union is against labor, now. That's what we're trying to change. We *want* to belong to the union and we'll gladly come back any time—at $14 a year."

"The union officials, they come to us and they say we should go through the proper channels"—Digiglio speaking again. "The proper channels, hell. We've seen a lot of that. Every man here knows you get a raw deal in the union courts."

"We've seen district and local meet-

ings," Miller says, "where there was ten hands up to one hand down and the president said 'Motion defeated.' We've seen meetings where they announced a vote of 500 was taken after we counted 200 men going in. We remember when the nomination for district officers was announced for 7 o'clock and we get there at seven to find that it was all over at six.

"We know it's the same way in the International. Our delegates come home from conventions and find out they voted for things they never even heard of. It was the same way with the so-called referendum on the International assessment. Sure the vote was 151,857 to 87,388, or so they tell us, but that's 240,000 voting out of a total membership of 600,000.

"No, we're through with regular channels. If they want us back, they've got to come to us."

Men Risk Jobs

What will happen if the union refuses to give ground? If their money gives out, the men will have to go back to their jobs—if they can get jobs. The union, after all, has a closed shop contract to supply the collieries with labor.

"We haven't looked that far ahead," says Miller. "All I know is that I will never pay that extra money if it costs me my job or my life. We all have big families, but we all feel that way."

How do the wives of the workers feel about it? Women are a big factor in a strike.

"We're with the men in this," says Mrs. Miller firmly. And her neighbors seem to agree.

"You know, women have never liked the check-off," said one.

Opposition to the check-off has become a prominent issue at strike mass meetings, although the strikers have said that they will accept two conditions—reduction of dues and assessments to the original $14 and election of new officers in District 7—as terms of settlement.

The strikers' demand for new officers has faced District President Brown with the fight of his life. He has given the soft answer that turneth away wrath and has promised there would be no reprisals if the men returned quietly to work.

"When they attack the increases in dues and in assessments they are simply going contrary to the democratic and long-established principle of the UMW, one of rule by the majority," he declared. "Both increases were duly ratified by a majority of the men they affect."

Brown stands pat on the verdict of the 151,857 to 87,833 in the referendum on the International assessment. As to the increase in District 7 dues, he asserts that 69 delegates, representing 15,000 members in the district voted for it while 24 delegates, representing 5,000, voted against it. (Miller insists that the proposal was tucked away obscurely in another measure and many delegates did not know they approved it.)

"Our dues are 50 cents a month higher than those imposed in Districts 1 and 9," Brown continued. "But the very good reason for that is our smaller membership."

The long depression in the anthracite field had depleted the total of duespayers, and all but five of District 7's 50 locals were "on the verge of bankruptcy."

Cites Wage Rises

Brown said the union had won wage increases and bonuses in the hard coal agreement last May that would more than offset new levies.

Some of Brown's supporters have hinted that Miller has "secret backing from AFL." They also point out that the strike leader has the support of a unionist named Patrick Hartneady, who has been at odds with Brown for some time and is said to have sought his office. Hartneady has appeared at mass meetings with Miller and makes no secret of his sympathies.

As for AFL, Brown himself discounts the charge.

"If Bill Green were to show his hand in this matter," he declared, "the uprising would end in a minute. They would want no part of anything in which Green had a hand."

In conversation Miller and his men are unmindful of national labor movement affairs, and uninterested in any discussion save that of their single-minded objection to having their money taken away from them. To many observers it has seemed strange that mine workers, traditionally the most militant of unionists, should thus rise against their own organization. But there is logic in the thought that the very descendants of men who fought the tyranny of the coal mine owners 40 years ago should be the first to battle what they view as a new tyranny when it appears in unionism today.

The fight isn't over. The strike may be beaten. But one valid conclusion has already emerged: Win or lose, *this thing has happened and it can happen again.* Any broader implications will have to be drawn by historians, not by Garrett Miller, Nick Digiglio, Eddie Kennedy, or Andy Rimsky, or any of their number. Talk to them and you will find them amazingly oblivious to the national significance of their deeds. So, too, were a band of "little guys who were tired of being pushed around" when they made their stand on Concord Green, long ago, and it took a poet to celebrate the "shot heard 'round the world."

Are the women backing up the protest against added union dues in UMW check-off? "Absolutely," say Mrs. Frank Maradeo and Mrs. George Gover

Power Trucks End Human Push and Pull

Machine tool plant, swamped with defense orders, starts from scratch with two power trucks, builds up a fleet of eighteen, regularizes interdepartmental moves

NELS SWENSON, General Superintendent, The Warner & Swasey Company, Cleveland

THE BALD FACT is that without some effective form of mechanical handling our plant today could not be in production on anything like our current scale. Every available foot of floor space in our factory is full of machinery and parts. The resultant volume of raw material, work in process, and finished parts would swamp us if it were not kept moving at a fast rate of speed between operations.

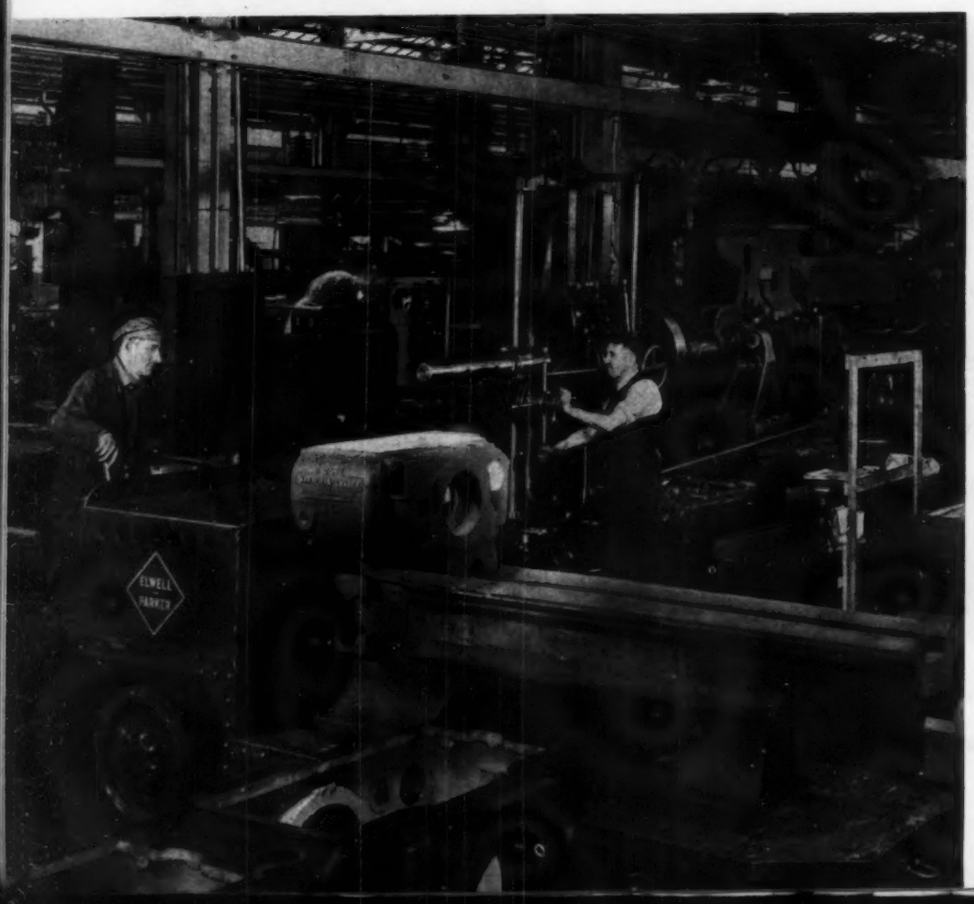
When the tide of orders began to rise about four years ago, we had a minimum of mechanical handling equipment. It is a fair statement that we used a small volume of mechanical transportation. But of mechanical handling, as we now understand the term, we had practically none. Across the street from our main factory building was a secondary building erected in 1917, reached by a tunnel beneath the busy thoroughfare. We used a couple of electric trucks to move material through this tunnel, and the probable reason why we shifted from hand trucking here was that we needed power equipment to get up the grade at the end of the tunnel. Elsewhere, we pretty much relied on human push and pull.

As our plant activity increased, we found the aisles and the space around production machines increasingly cluttered with work in process. So we added a power truck here and another there, until it became apparent that we had better get the entire transportation job systematized and under control. From this thinking evolved our plant transportation department, and the mechanical equipment with which the transportation department performs its task.

As we undertook to analyze our mechanical handling problem, we found ourselves dealing with the circumstances of our physical plant and of our production job. The older unit is a large multi-story building; newer units, including better than 100,000 square feet added within recent months, are single-story. The entire plant is situated between a railroad main line and two of the most heavily traveled streets in Cleveland. We had, therefore, a transportation problem that involved working on several levels, in several buildings, and through a tunnel connecting two of the plants.

The materials with which we work range from castings of several tons—for the beds of our largest turret lathes—down through medium-sized castings and forgings, to tiny pins and gears. Most of the parts are so small that for efficient moves they must be handled in containers.

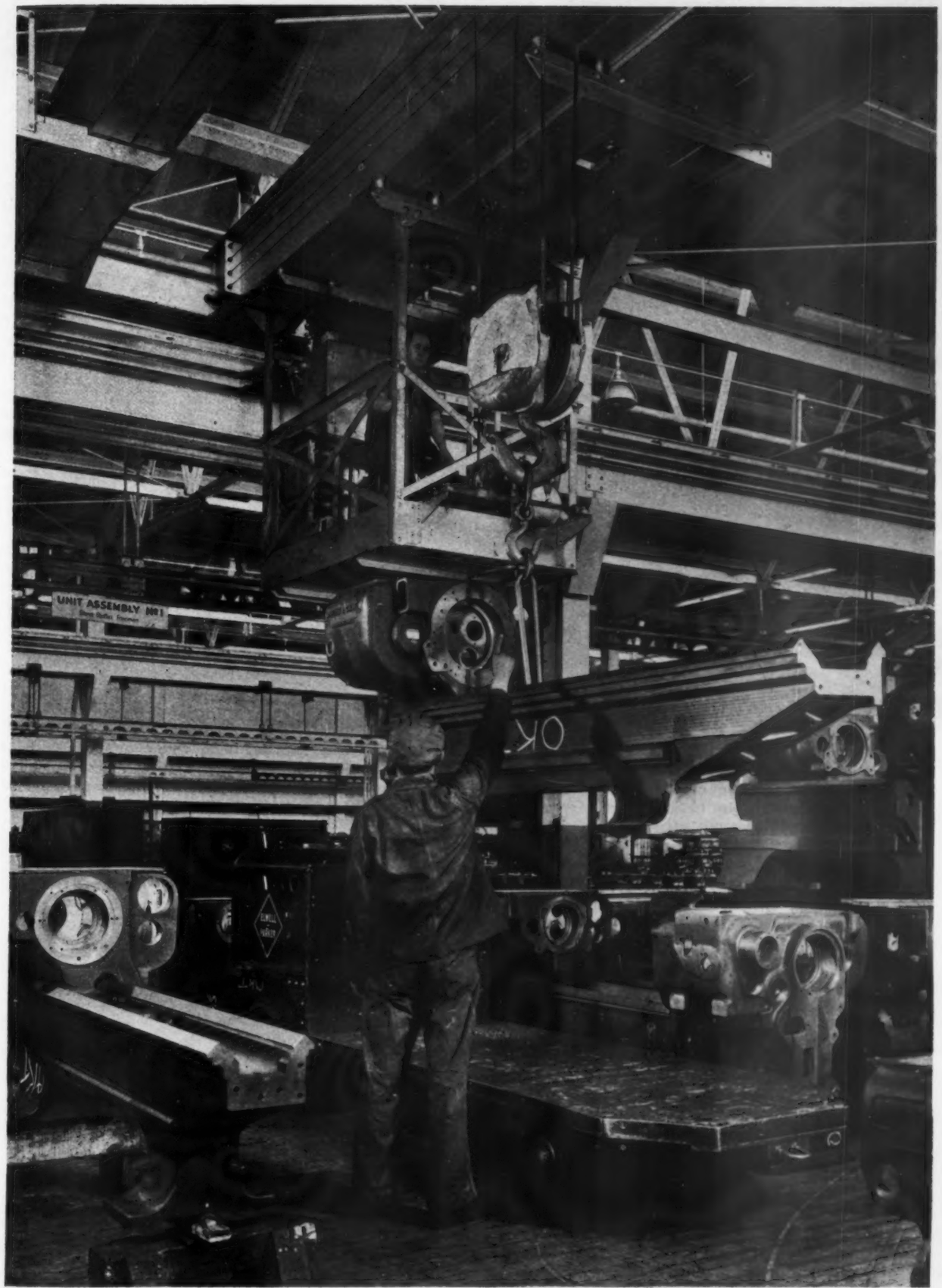
Rough bed plate casting arrives by platform truck to await its turn at first machining operation in background, where approximately 250 pounds of metal will be taken off. Crane does the picking up and putting down



Dozens of Special Tools

Perhaps most significant of all the influences upon our choice of equipment, our production is not line production as this is understood in, say, the automobile or laundry soap industries. To be sure, we have only two basic machines, and our catalog shows only eleven different models. But also, alas, our catalog must show dozens of special attachments and tools which are optional with the purchaser. And if, as occasionally happens, the purchaser requires still other variations to fit our standard design to his specific production problem, we have to provide these even though they are literally designed and made specially for the one machine that he is buying.

The consequence of this lack of standardization is that we cannot keep work flowing through the plant in a



Electric platform truck and overhead traveling crane collaborate on heavy move job. Crane lifts finished machine bed from truck, carries it off to storage where it will be held until needed for final assembly

Smaller castings from outside foundries arrive at the plant on skids, are moved by power truck to classification floor located on one of the main thoroughfares. Some castings remain in classification several days; others are started to machining within an hour or two of arrival. Note pads used to cushion sharp edges. Cards shown are "shop travelers" which accompany each lot all the way to final assembly

steady, even-paced parade. It takes longer to build a turret lathe equipped with numerous special attachments than to build one that is exactly as listed in the catalog, even if every piece, subassembly, or attachment is ready at the precise moment when the machine is ready to take it. In shop practice, as any experienced production man knows, there are delays even in times when everything is plentiful—and these delays are proportionately more troublesome now. Thus a special job not only takes longer to assemble, but it also has to stand around now and again awaiting completion or arrival of its individual attachments.

After we had considered our multistory and spread-out geography, our essentially job-shop characteristics, and our irregularity of production flow, we saw that we needed maximum flexibility in our mechanical handling system. We were already using electric trucks, and knew from experience that they accommodate themselves easily to flexible demands. As we might further expand our production, trucks could be added to meet the increased transportation load. So, we made our decision about equipment.

Teaming Up Handling Equipment

Within the production departments and the allied units of the plant, we should continue to use whatever type of equipment fitted the specific problem at hand there. That is, intradepartmental transportation would use the tool that seemed indicated by the job at hand. For interdepartmental moving of materials, we would standardize on electric trucks, using platform units for some applications and lift trucks for others, according to the requirements of the task.

This literally means a teaming together of assorted mechanical handling equipment. For instance, a bed casting weighing several tons arrives at the truck dock on a motor truck. Two electric hoists serve this dock. A chain sling is used to lift the casting on one of the hoists. It is laid upon the platform of a power industrial truck, carried to its destination, there handled by an electric crane either to the floor for temporary storage or to the bed of a planer for the first machining operation.

On the other hand, consider incoming castings of smaller size. These may be in steel-ringed skids when they arrive. An electric lift truck enters the motor truck, picks up a skid with load, and transports it to the receiving dock. Here the castings are reloaded upon skids; burlap pads are inserted between the castings to prevent needless damage during transportation. Now these skids are delivered to the classification floor, from which they are taken to production departments as needed.

Inside the promotion departments, work is handled in a wide variety of ways. There are electric cranes, jib

cranes, electric hoists, monorail hoists, chain falls, floor dollies operating on tracks, hand lift trucks, hand push trucks, probably other methods of handling that fail to come to mind at this moment. The work comes to the department by electric truck, whether lift or platform, and is deposited either alongside the main trucking aisle or alongside the machine where it will be used. From here it is handled by the production department—by the machine operators, by the inspectors, or by the truckers employed in the department. When it passes the final operation in the department, which usually means when it passes inspection, the last man to work with it places it at the loading station where the power trucker will find it next time he comes along. If it goes to another floor, the truck with the load goes by elevator.

The transportation department was organized as the outgrowth of our decision to systemmatize our mechanical handling. It is headed by a foreman, who is responsible to the general superintendent. This foreman has charge of the eighteen electric industrial trucks that constitute our current equipment. His department handles

Warner & Swasey's fleet of eighteen industrial power trucks keeps work on the move. Machine assembly begins with delivery of special racks of finished parts from stock to various points on the assembly floor

Turret-lathe bed plate is brought in by motor truck, transferred by electric hoist to platform-type power truck, moved to machining operations

all interdepartmental moves. It is used on intradepartmental moves only occasionally, when a foreman of some other department needs help and requests it. In this event, the transportation department ordinarily assigns a spare truck and trucker to the production department, subject to the orders of the production foreman until the emergency situation is cleared up.

Unlike many central transportation departments, ours does not operate on a regular schedule of pick-ups and deliveries. Instead, we do it in precisely the opposite manner—because we feel sure that, under our particular circumstances, an unscheduled service gives the best results.

Trucks Are Kept Busy

For transportation purposes, the plant is divided into some fifteen divisions, each division composed of one or several departments, depending upon the volume of trucking that it requires. The effort is to set up each division so that it provides approximately the right volume of work to keep one truck and trucker completely busy all the time.

Each trucker is assigned to his own division. His primary responsibility is to keep this division clear of all outbound loads. He has the type of truck that fits his duties; eleven of our electric trucks are lift trucks, seven

Skids loaded with finished parts—gears, in this case—proceed under the original "shop traveler" to stockroom in factory sub-basement. Moves to, through, and from stock are exclusively power-truck jobs

are platform trucks. Therefore he takes away all outbound loads just as rapidly as they accumulate, or as rapidly as he can. When he delivers a load at destination, he looks over the outbound loads awaiting there; if there is anything going anywhere within his own division, he picks it up and takes it back with him. But, if there is nothing at destination addressed to his division, he hustles home empty, rather than go looking elsewhere for outbound loads, or take loads destined to divisions other than his own. After all, under our policy, the trucker attached to a division is on hand to move any outbound loads originating there; any help he gets from the other fellow is just so much candy for him.

Sole exception to our "no-schedule" policy is the toolroom. Here the trips are scheduled for pickups at 9, 1, and 3 o'clock on the day shift, because this method is sufficient to keep the floor clear, and permits the truck to be used elsewhere during the rest of the day. Night moves from the toolroom are made only on special orders, usually because some production department needs something that the toolroom has made for its use.

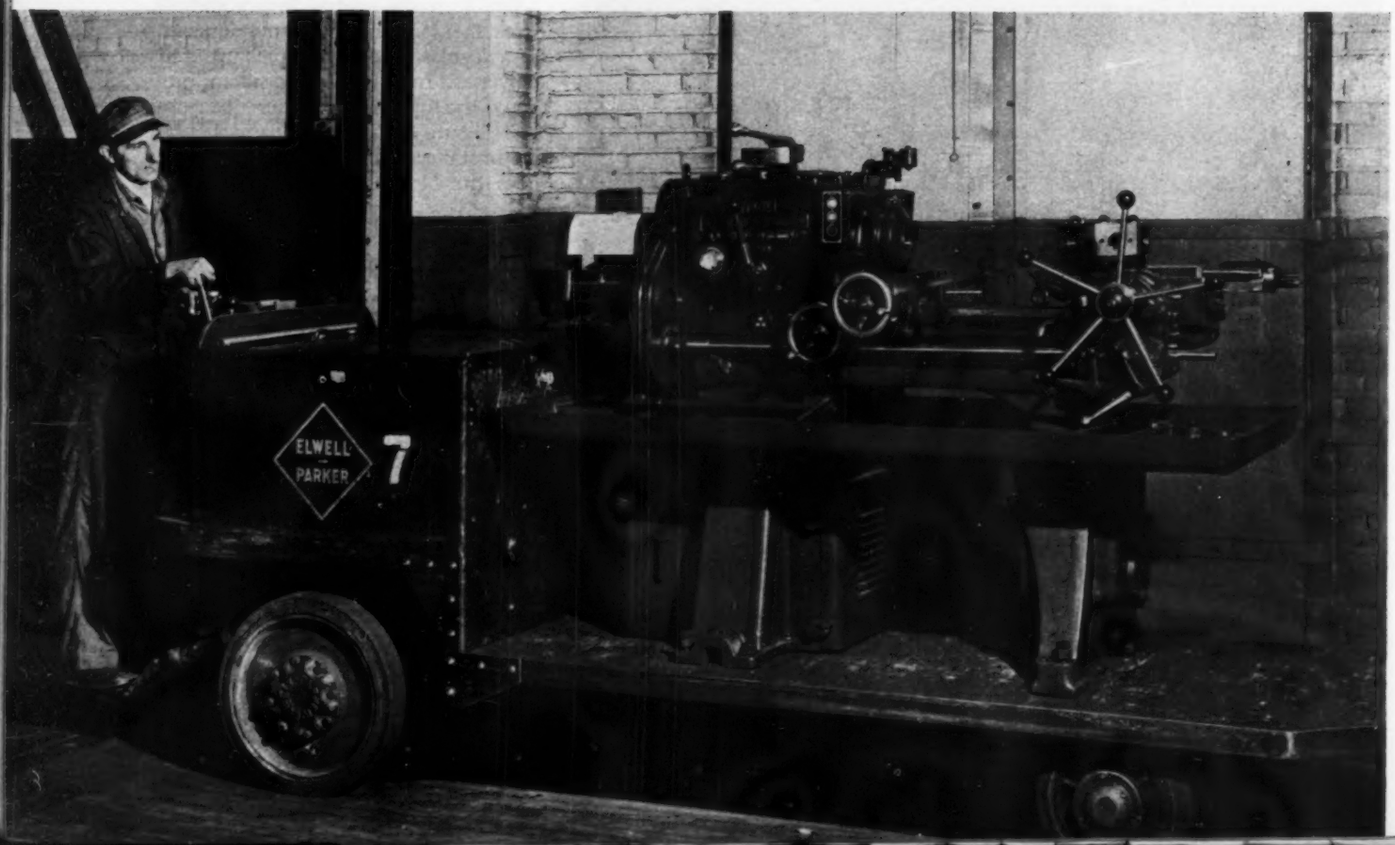
Some of the trucks are assigned to special duties, either part or full time. For instance, one truck is used all day to move oils—cutting, lubricating, and miscellaneous—from oil storage to production departments, and to return the empty containers. Another truck is used on clean-up, removing rubbish throughout the plant.

In the interdepartmental transportation of materials and parts, we use a wide variety of special toteboxes, trays, racks, and the like. These are carried on skids, but are entirely separate from the skids. We examined carefully the possibilities of building special fixtures on skids, but decided against it in all but a very few cases. With a special carrying device permanently attached, a skid is so restricted in usefulness that any such policy would greatly increase our requirements for total skids. As it is, we have more than 5,000 skids.

Unattached boxes carried on skids

(*Continued on page 150*)

Assembled turret lathe is moved by industrial power truck to the inspection department, thence to crating for shipment. Truck and its load traverse the Carnegie Avenue tunnel, travel via elevator to first foor of main plant, then by a second elevator to the crating section on the second floor of the new building



First Aid in a Blackout

Only practicing, these girls and men of the voluntary first aid crew at RCA Manufacturing Company, Camden, N. J. They're blindfolded to get the feel of working in a blackout. Crew is unit of National Civilian Defense, holds Red Cross certificate. Five members did actual emergency work during $1,000,000 fire which destroyed the buildings that used to stand where the practice drill was held

No Cost Control, No Profit

When cost control clicks, management clicks, employees collect, stockholders chuckle. All because cost control shows the way to better performance, greater output, less waste, satisfactory profits

WALLY E. GEORGE, Assistant to the Management, Campbell, Wyant & Cannon Foundry Company, Muskegon, Mich.

HAVE YOU EVER REALIZED that quite possibly your costs already are low enough—IF? *That is to say, IF you can hold your costs to standard figures,* you probably will have the profits you need for the tax collector, for surplus reserves for a rainy day, and for fair dividends for your stockholders. But more often than not, you fail to come up to all the expectations of your pricing estimates.

Depending on how well you meet standard costs, your dollar of sales assumes varying proportions in make-up, quite possibly along these lines:

Performance	Sales and Administrative	Shop Costs	Normal Profits	Total
Standard	$0.20	$0.70	$0.10	$1.00
Average	0.20	0.75	0.05	1.00
Mediocre	0.20	0.80	0.00	1.00

If your performance is below standard, in the "Average" or "Mediocre" class, probably what you need is not *cost cutting,* but *cost control.* If you want the academic definitions, ask an accountant, but if you want practical ones, accept these (or write your own):

Standard Costs—the normal low cost used when you figured your selling prices.

Cost Control—the accomplishment of systematically meeting all elements of standard costs on labor, materials, and expense items.

The drawing on the facing page illustrates a simple equation which tells the whole story of cost control at a glance.

You can control costs only by knowing in advance what they ought to be, and by passing this information along to your foremen and others of the supervisory group who are spending money every day for labor and materials. Standards are variously stated as piece rates, time allowances, budgets, quantity formulas, ratios, and so forth.

Standards are needed for (1) production schedules, (2) direct and indirect labor, (3) fixed costs (so-called), (4) materials, (5) expense items.

Men rarely bat .300 for a season, bowl a 200 average, or shoot golf in the 70's without benefit of scorecards. Good cost control likewise demands these yard sticks.

Schedule boards, reports, and charts all serve graphically to tell the story. Put your bogey or budgeted allowances in one column, and put actual results in another. Throw the spotlight both on good showings and on bad. Let workers, foremen, and executives all see what the daily ratings were, and what the fall-downs amounted to.

Do this every day, every week, every month—even every hour if it stimulates better results. Keep score on schedules, hours used, units of output, materials consumed and wasted, products damaged and scrapped, electric power required, plant maintenance, labor turnover—on costs of every description.

Volumes have been written on why men achieve performances *par excellence.* Love of power, personal ambitions, inner satisfaction, desire for promotion, all may contribute, but the blunt fact remains that money incentives talk louder than any of them.

Incentives are the sparkplugs that bring smooth and continued firing, after you have standardized and synchronized your motors of industry.

Piece rates, time-and-bonus payments, cost reduction plans, profit-sharing pools, and extra compensation represent a few of the many forms of incentives in use in industry today. Doubtless each one has its place. Rightly used, they become strong and dominating factors in the equation illustrated on the opposite page.

Lower costs, higher earnings, and greater profits come as the natural result when essential ingredients of cost control are properly combined. The trick is in the mixing.

Essential to real cost control is a comprehensive view of the whole pattern of manufacturing costs, plus a keen sense of relative values. But perspective and vision have to be correlated with penetration and vigilance. Studied analyses must be followed up by persistence and directness of action. Every channel of waste must be blocked, all the loose ends of expenditures caught up.

To get you started in the right direction, we tabulate below some tried and practical suggestions for controlling costs:

Production Control

1. Schedule production three days to a week in advance, and do so with full regard to customer requirements and to personnel, material, and machine capacities.

2. Avoid hasty and unjustifiable schedule changes, yet keep your schedules flexible.

3. Check production on principal lines hourly, daily, weekly, monthly. Broadcast performances on bulletin boards.

4. Record the cause and measure the cost of every production delay or interruption to schedules. Correct or eliminate the troubles rather than simply fix the blame.

Labor Control

1. Cover all direct labor operations with standards.

2. Budget indirect labor in each

Born in Indianapolis in 1899, Wally E. George was graduated from Georgia Tech in 1921 with a B.S. degree in Civil Engineering. Was supervising engineer for the Haynes Corporation, head industrial engineer, American Steel Foundries, and since 1937 has been assistant to the management with Campbell, Wyant & Cannon Foundry. Golf in the 80's (maybe sometimes the 90's), flower gardening, and bridge are favorite occupations in his leisure hours

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department, using either direct labor ratios or money standards per unit of production.

3. Schedule workers departmentally, both for operating and for non-operating days.

4. Use daily, weekly, and monthly productivity rating sheets on all direct labor, showing individual or group and department ratings.

5. Each day compare actual indirect hours for every department.

6. Do not permit the mixing of piecework and daywork in one day by any one individual or group.

7. Watch piecework earnings carefully, eliminating shortage allowances as far as possible.

8. Record labor charges where they belong.

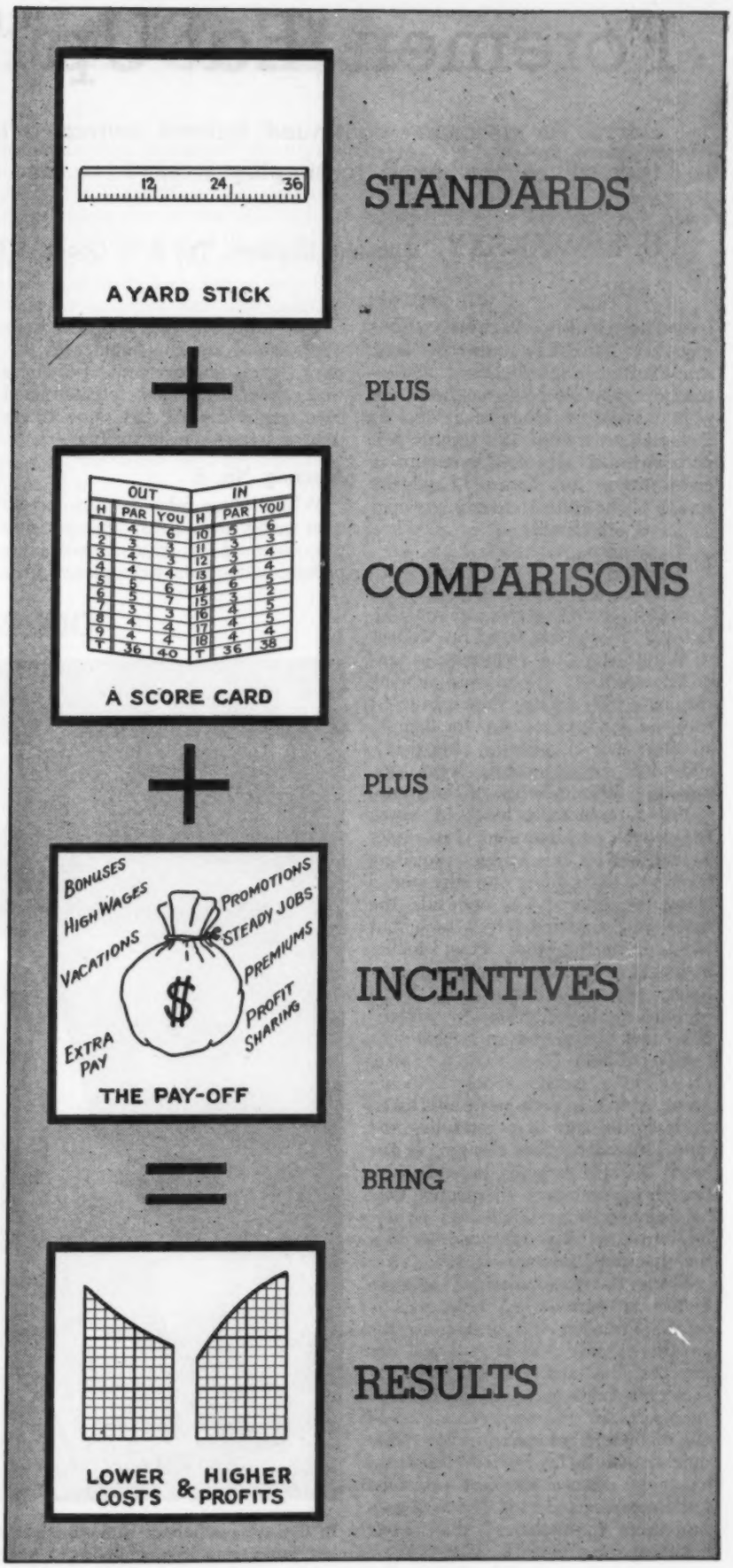
9. Cut out overtime completely.

Materials Control

1. Set up standards for raw material formulas and quantities. Check daily for deviations of any sort.

2. Set up standard allowances for quality or scrap control. Post actual

(*Continued on page 154*)



Foremen "Eat Up" This Work-

Part 2. As the course continued, interest increased, and foremen began to find for themselves new ways to simplify work, save time and effort for operators

S. L. WANSKY, Industrial Engineer, The B. F. Goodrich Company, Akron

LAST MONTH MR. WANSKY *related how the Goodrich course in work simplification originated, and who attended. The objectives of the course were outlined, and the first six sessions described. In this, the second half of a two-part article, the remaining eight lessons are discussed, and the results of the course, including savings achieved, are shown.*

Meeting No. 7

Four or five ideas were presented by the foremen regarding eliminating holds with the left hand, as well as reducing stopping, excessive transports, and delays. Whenever possible, the materials or devices were brought into the conference room for demonstration and discussion. Invariably, additional improvements were suggested by other members of the group.

For a problem, a block of wood, 6x5x1 inch was provided; ⅜-in. holes were drilled on 1-in. centers, providing 6 rows of holes along one edge and 5 along the other. On one side the holes were chamfered to ¾ inch, but left plain on the other. Pins 3 inches in length were made to slip into the holes, one end of the pins being rounded and the other cut square. The block was placed on a table with chamfered holes down. The pins were placed in a carton about 2 inches deep. A man in each group was asked to look the job over carefully, and then proceed to place the pins in the board as efficiently as possible. Although in most cases an effective two-handed operation was devised, no one reversed the block of wood so that the chamfered side appeared.

Using the same method, approximately 50 percent less time was required to insert the pins from the chamfered side. This example was used to illustrate how, in many instances, a thorough job observation on the part of the supervisor would enable him to get rush jobs out more quickly than by leaving it to the direct worker to discover the best way. One foreman remarked: "If I don't learn something from that, I shall never learn anything."

The transport and grasp motions were defined and illustrated with pictures, and improvement principles were discussed. The foremen had been taught how to read. Now it was time to teach them to spell.

Meeting No. 8

While some jobs in the factory were being investigated, an operation was observed in which small brass plated metal parts were placed in a wooden rack preparatory to spray cementing. In placing the parts, the operator was holding them with her left hand, transferring to her right, and then placing them in position. It was pointed out to the foreman on the floor that it would be easier and quicker for the girl to place the parts with both hands, starting at the center and working out. The operator was shown how to do the work this way, with a big saving in time.

OLD METHOD

In the old method of removing rubber grommets from center plate of mold, left hand was idle while right hand punched grommets out one at a time

Simplification Course

The foreman claimed that the reason he had not shown the girl how to use both hands effectively, was because the job was new. This opened the way for stressing the importance of insisting on right motions from the beginning, on the first day of work, and not after bad habits had been formed. In this meeting, three loop films were shown of jobs which illustrated good use of both hands, and foot-operated levers. Suggested improvements were discussed on three more jobs that had been picked up by the foremen. Also presented were the *position, hold,* and *release load* therbligs.

One suggestion was brought to the instructor by a floor foreman, before it had been taken up with departmental supervision. It was conveyed that the proper procedure would be to handle these matters in the regular manner, and that the instructor would be glad to consult on any problem. It was impressed on the men that it was not the intention of the instructor to interfere in the process of putting new ideas into effect, but to help the suggester with his idea, and tabulate the resulting savings.

It was also noted that a "must" feeling was entering into the attitude of the foremen about submitting improved ideas. In my opinion, it was an unhealthy attitude, and was apparently the result of a departmental meeting to create a competitive spirit. This spirit was discouraged.

One foreman was not sold on the correctness of a motion economy principle that has been discussed in the conference room and applied to one of his jobs. He was allowed to perform the work in class, using both principles, and stopwatch times were compared. The lowered time when the improved method was used convinced the foreman.

Meeting No. 9

Pre-position, select, and *search* motions were presented to the groups. A short loop film was shown, in which the men were asked to make a simultaneous motion chart of the operation, using therbligs discussed so far. The foremen seemed to handle the therbligs with ease, and almost all of them recognized the faults of the job as shown on the screen.

An interesting improvement was brought to the class. The old way of inspecting a composition ball for flow cracks at the mold rind required the girl to pick one up and squeeze it between both hands, to flatten it out so that cracks could be seen. Since it was a stiff compound, a heavy squeeze was required, which proved to be highly fatiguing.

To improve the operation, the foreman obtained an old roller bearing, tacked it to a board, and clamped them both to the bed of a drill press. The operation was then performed by placing the ball on the bearing, and bringing the revolving chuck down to flatten the ball. This permitted the ball to be squeezed to a greater degree and, as it revolved, the cracks could be readily seen. This idea served as a good illustration of using what was already available to good advantage.

Meeting No. 10

More ideas. More improvements. Some suggestions were made by the instructor regarding jobs that had been observed. These suggestions were noted by the foremen, who immediately went to work on them. Of interest on one particular job was the fact that one operator, when working on a unit on one side of the table, used her left hand to get the material and transferred to her right before proceeding. When asked to grasp the material with her right hand and eliminate the transfer, the operator found it highly awkward and almost impossible to do. Yet, when she moved to the unit on the opposite side of the table, she performed the job exactly as we requested her to on the first side. This served as an ex-

NEW METHOD

Here is new method for the operation shown on opposite page. An adjustable, multiple-point tool makes use of both hands, and saves a lot of time

New method of facing rollers makes use of a drill press, a small, inexpensive jig, and a discarded facing tool. Old way was for the operator to hold the roller against an abrasive wheel. How to simplify operations by using discarded tools rather than expensive new equipment, was one of the results of the course

cellent illustration to show the foremen the effects of habit.

Various gadgets were brought in and demonstrated. Their small cost was contrasted to the large savings obtained from their use. A small tool shaped from a tobacco tin was perhaps the most impressive. The idea that a production department with lots of gadgets showed progressiveness was driven home.

Meeting No. 11

A moving picture "Harvesting Vegetables" obtained from the University of Iowa Visual Instruction Department was shown. The picture illustrated the use of gadgets as well as various methods of performing the same work, with the results tabulated. The prime reason for showing the picture was to provide some respite from the intensive training, by showing a job outside of the department and still pointing out a few principles in motion study.

Meeting No. 12

Improvement ideas really started to pour in. Five new ones were discussed, and two were further improved in this conference. There was an interesting sidelight on one new method. Shortly after the suggested method had been put into operation,

(*Continued on page* 156)

Improved way of cementing wringer roll shafts is to place gravity tray so that shaft is in position to eliminate select motion, and to cut hole in table to relieve excessive reach. Old method required long reach and body bend to dispose shaft to tray, while right hand groped for next shaft

The Foreman on His Job

In the hurry-hurry battle of production the foreman is the man in the plant who can free the key log in the jam. But he's new. Or, if he's old on the job, he finds his department bigger, his force increased, his problems multiplied and magnified. So he needs help. All the help he can get. And here is help—two more chapters from A. L. Kress's forthcoming book—chapters that show the foreman how to improve methods, plan production—all with a view to making best use of men, materials, and machines, whether on defense or non-defense work

A. L. KRESS
Industrial Engineer

FACTORY published two chapters from A. L. Kress's forthcoming book in June under the title "Foremanship Fundamentals," which proved so useful, judged from the number of reprints ordered, that the editors asked for two more chapters, published in the following pages as "The Foreman on His Job."

Kress also wrote "How to Rate Jobs and Men" (FACTORY, October, 1939), out of his experience as director of the National Metal Trades Association's job rating program, and prior to that as director of the industrial relations program for the National Electrical Manufacturers Association.

He's been rodman, construction engineer, purchasing agent. Was with U. S. Rubber for many years, first as industrial engineer for a single plant, then for a division of ten plants, finally as chief industrial engineer for the entire company. Graduated from the Harvard Business School. At present he is serving as consultant to the Aeronautical Chamber of Commerce on job classifications in the aircraft industry.

Forty-seventh in the Series of FACTORY MANAGEMENT and MAINTENANCE Plant Operation Library

I. Improving Methods

HAVE YOU EVER WONDERED what changes a new foreman might make in your department if he were to take over next month? Would he be more critical of things as they are than you have been? Of course he would make changes, possibly some that you have thought about but somehow never got around to making, or else could not "sell." Do you suppose he would think that you knew your job, or would he wonder where you had been to let some things get by you? Rest assured he would make changes.

Think it over. Perhaps you can put yourself in his place and see your department as the new foreman would see it, critically, questioning everything, asking himself *why*. That word *why* is an important one. We all ought to use it more often.

Let us go a step further. Suppose you come in some morning and pretend you are the new foreman. You hold no brief for anything that is being done. In fact, you are looking for constructive changes to prove you are on your toes.

Now, what do you think of the general layout of your department? Perhaps you never thought about it before. How does it look to you? Is it orderly, clean, well arranged, with a place for everything and everything in its place? Would a coat of paint or even whitewash make it a lighter and better place to work? Even that can make a difference in employee attitude and quality of work. How well has the equipment been maintained? What is your general impression of quality and output standards? Are too many men waiting at the tool crib, at their machines for tools or material?

The Things to Question

You can go down the list of things you would want to question. In this chapter we shall suggest various points you can check. In general, anything you are doing in the same way you did it four or five years ago is open to question, *for change is the very essence of good management*. It is only fair to recognize that you may have been unable to "sell" good ideas, even though you have tried several times. Sometimes top management itself gets "hardening of the arteries" and is not receptive to change. Self-satisfaction and complacency are luxuries that no management can afford.

We make progress in industry only as we make changes. Whatever we did a year, two years ago, ought not be good enough next week. There is nothing mysterious about the development of new methods. When you walk into a department that at once impresses you with its effectiveness, you can make up your mind it got that way because somebody approached the problem with a new viewpoint, looked at things critically, saw them as they actually were, recognized their shortcomings, then took off his coat, went to work, and did something about it.

Right Mental Attitude

In short, the development of new and improved methods is almost entirely a problem in developing the right mental attitude. That is not easy. We are all just naturally opposed to change. We do not like to have to do things differently. Think how you react if the family switches your breakfast food some morning! So we have to overcome this natural reluctance to change if we are going to improve methods. You can do it if you will:

1. Understand some of the basic principles of good management.

2. Develop an analytical, inquiring mind.

3. Be dissatisfied with things as they are.

4. Develop ingenuity in thinking out better ways of doing things.

5. Acquire patience and persistence in selling ideas and, above all, in staying with them until they are completely worked out.

6. Shun the three alibis of those who are always satisfied with things as they are: (a) Conditions are different in my department; that might work somewhere but it won't here; (b) we tried that once; (c) we've always done it this way.

We may as well recognize that it means work every time we do change a layout, procedure, or method. Someone has to get in and put it across. There is invariably a testing period when almost everyone begins to doubt whether the change really will work out. But, if it is basically sound and we have the right man to follow it through, we need not be alarmed because we run into difficulties in the development stage. If these things were easy, somebody else would have done them a long time ago. The fact that an idea may have been tried once, unsuccessfully, is no reason for not trying it a second time, if we can control the reasons for its first failure. Progress often consists only of trying again ideas that failed to work out before.

Plant Layout

In the average company, plant layouts get little or no attention. It is so long ago that departments, machines, or workplaces were placed where they are, that no one remembers the reasons, if indeed there ever were any. Yet low-cost materials storage, economical handling and trucking, and the use of progressive assembly methods, all depend on whether we have a good layout.

There are two basic types of layout. The older and more common might be called the "departmentalized" type. Equipment is grouped according to kind or type. Thus all milling machines are located in a unit together, or all engine lathes, or all drill presses. Under this conventional (because it is so common) type, we should have a drill press department, a milling machine department. Whether the departments are under separate foremen has nothing to do with the type of layout. With a departmentalized layout, we move the work back and forth from one department or class of machines to another.

The other layout may be called the "functional" type. Here, instead of moving the work back and forth, we set up "production centers," bringing together a battery or group of *different* types of machines required to produce a piece. We might even move certain machines into a center or line, where an extra operation was necessary. For example, a piece is to be routed successively to an engine lathe, a drill press, and an external grinder. Under the functional type of layout, these three machines would be set in the line, or adjacent to one another, so the casting could be passed from one machine to the next, possibly on a roller conveyor. In other words, we bring the machine to the work, and not the work to the machine.

Which of these two basic types should be used, depends on the standardization of the product and the quantities to be made.

The departmental type of layout is particularly applicable to a jobbing shop or a processing industry (such as a chemical plant or flour mill). In a jobbing shop the demands on the various types of machines vary widely. It may be necessary to schedule work for a bottleneck operation, making

no attempt to balance machine hours on other machines.

The functional type is particularly applicable to mass production industries where large quantities of a few standardized products are manufactured. Here it is necessary to balance the machine loads, but the balancing is done by placing enough machines in the line.

Review your departmental layout, keeping the following points in mind:

1. Weigh the merits of the two types of layouts, and decide which one fits your problems better. Remember the functional layout is more likely to be applicable to repetitive manufacture.

2. Flow of work should be in as nearly a straight line as possible, with a minimum of backtracking.

3. Aisles should be marked off on the floor, and kept open for trucking.

4. Work-in-process should be held to a minimum. It is a sign of poor production control to find excessive banks of work between operations.

5. Keep material off the floor, preferably on conveyors or lift truck skids, and *keep it moving.*

6. Locate machines so that one man can operate more than one.

7. Locate subassemblies adjacent to where they are to be fed into the main assembly, rather than on a departmental basis.

8. Departments should be well lighted.

If you want to study your present layout, get the engineering department to give you a floor plan to scale (perhaps ¼ inch = 1 foot), then cut out some templets of the machines and workplaces, also to scale. Try out different arrangements to see which would give the most efficient layout. Get your recommendations together, then sell the idea to your superior.

More Production on Machines

Machine-tool builders have done an outstanding job in recent years in redesigning machines to simplify operation, increase precision, and eliminate unnecessary motions. However, the individual plant will always have to work out the most effective operation of the machine on its own products. This is a responsibility that is shared by the foreman and superintendent, and in the larger plants by the tool engineering and the methods departments. The tool engineering department is not as a rule sufficiently "methods-minded" to analyze the actual use of a proposed jig or fixture from the standpoint of economy of motion and ease of operation. That is one reason why a foreman should be able to analyze machine operations and spot poorly designed set-ups.

Suppose you walked into a department and saw a drill-press operator. As you watched him, he bent down, got a casting off the floor, fumbled around trying to hold it in place, finally drilled 3 or 4 holes. Then he tossed the casting back on the floor where it waits for a moveman to come along and load it into a totebox. It would not take you long to conclude that the whole operation was grossly inefficient. By analyzing the operation step by step, you could determine what changes in methods could be made to eliminate wasted effort and to increase output.

Analyzing a machine operation to improve methods and increase production calls for only two things—the ability to break down the operation into work-steps or elements, together with some understanding of what to look for. Two excellent check lists of "what to look for" on machine operations are given below.* While the author was mainly addressing himself to tool engineers in terms of repetitive work, you can use the lists to check some of your own jobs. Although there is some duplication between the two lists, the points are so excellent and so clearly made that both warrant reproducing. Study every one of these suggestions carefully, and see if you can put some of these ideas to practical use on your operations.

Here is the first—many of the points are just as applicable to hand operations:

1. Is the job safe for the operator?

2. Is there sufficient leg room so the operator can operate the equipment while seated?

3. Is the work level slightly below elbow level when the operator is standing?

4. Does the design permit loading and unloading of the fixture without "change of control"?

5. Is the work equally distributed between both hands?

6. Can a mechanical ejector be used to remove the piece from the fixture?

7. Have all barriers been eliminated from the movement path?

8. Can a foot pedal be used to free the hand for other useful work?

9. Have bullet-nosed pins, guides, or bell mouths been provided to reduce "lining up" movements?

10. Have mechanical holders been provided to eliminate the operator's hand as a holding device?

11. Are all control levers centralized and within normal work area?

12. Are all levers "quick acting"—toggles and cams instead of screw clamps?

13. Can control levers be designed to serve multiple functions?

14. Has sufficient chip clearance been provided?

15. Can chips be washed or blown off automatically?

16. Have fast feed to, and return from, the cutting point been provided?

17. Has the design provided for simple change-over to reduce set-up time?

18. Will the upkeep of the fixture be low?

19. Has the fixture hourly output been adjusted to the "line balance"?

And here is the second check list:

1. Replace hand movement by automatic movement.

2. Replace hand movement by foot movement.

3. Eliminate the passing of work from one hand to the other.

4. Provide hand levers, etc., with multiple functions.

5. Provide means for finished work to drop from fixture into discharge chutes.

6. When drop discharge cannot be used, arrange for disposing directly in front of operator—over top of machine is often a good solution.

7. Arrange for getting new work from hopper or chute as close as possible to discharge point, to overlap movements.

8. Eliminate the use of the hands as holding devices.

9. When possible keep hand movements within radius of forearm from elbow height up and away. In any event, keep within radius of full arm without body bend or twist, and without necessity for stepping to reach point desired.

10. Eliminate barriers so that movements can follow shortest path.

11. Keep both hands busy with useful work and avoid wait of one hand.

12. Provide double station fixtures.

13. Eliminate hard-to-find controls,

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* *The Tool Engineer*, Feb., 1941, Better Methods—Start With the Engineer, Guy J. Bates.

such as small buttons that require eye directing.

14. Aid locating by means of slides, guides, flanges, stops, bell-mouth holes, and bullet-nosed pins.

15. Separate scrap from good parts.

16. Keep eye movements within small space, about a 6-in. circle.

17. Avoid necessity for operator assuming uncomfortable position. Most work should be at elbow level.

18. Build controls of proper size, shape, and weight, and build to operate without undue effort.

19. Build foot pedals so that they may be operated with comfort by either foot.

20. Where feasible, arrange so that machine can be operated equally well from standing or sitting position. This is best accomplished by arranging to work at elbow height when standing, then providing high posture chairs so that operator may sit and still work at elbow height. When foot controls are used, it is generally necessary to provide upper and lower pedals.

21. Provide definite location for loose tools. If possible, mount in position for use, to require as little handling as possible.

22. Make all controls "quick acting." Use toggle or cams instead of screw clamps.

23. Design machines for loading so that tools such as pliers, tongs, etc., do not have to be used to place the parts in fixture.

24. Where possible, levers, such as feed handles on single spindle drills, should be made reversible so that they can be operated by either the right or left hand.

25. Design machines as much as possible to shed oil and dirt, by eliminating flat horizontal surfaces.

26. Provide sufficient place for chips and turnings, and make these places easily accessible for cleaning out.

27. Provide sufficient toe space to allow operator to stand up to machine as he should.

28. Provide compound lines large enough to keep chips and turnings washed off fixtures, to relieve operator from the necessity of having to brush or blow them off.

29. Provide for easy, simple, and quick tool and set-up changes.

30. Provide for fast feed of tools or carriages to work, and fast return to unloading point.

31. Make the job safe for the operator. Do not sacrifice safety for motion economy, but strive for both.

In addition to the above points, check up on the following:

1. What is the relation of handling time to machine time? How much attention does the machine actually require? Has the operator any idle time while the machine is performing that could be utilized by having him operate more than one machine? This may require some rearrangement of machines.

2. What about the cutting tools? Are they the most effective on the market? Are they being properly cared for to give best results?

3. What about the speeds and feeds? Are they the most effective for the material involved?

If you want to increase output per man-hour, review all these points carefully, draw up your recommendations, put them in a written report to your superior, with your reasons why you think they should be adopted, what they would cost, and what the probable savings per year would be.

Subdivision of Labor

There are two basic reasons why American industry is so productive—(1) the steadily increasing use of horsepower hours per employee, and (2) the wide application of the principle of subdivision of labor, or specialization. We usually think of the automobile industry as the outstanding example of these two trends. If it were impossible to make interchangeable parts, or break the manufacture of a product down into a series of specialized "single-purpose" operations, the cost of a car or an electric refrigerator would be so great that few of us could own one.

Subdivision of labor is an old principle, equally applicable to management as to machine or hand operations. For example, take the foreman's job in the larger plant. He is no longer expected to be an expert in maintaining equipment, rate setting, industrial relations, materials testing, fixture designing. When such problems get complicated, we set up a staff department to specialize in them. So, in a broad sense, we apply subdivision of labor to management, which results in setting up "functional" departments such as purchasing, industrial relations, tool engineering, and so forth.

As we narrow a person's field of activity, we increase his skill and specialized knowledge in that field. The man who works with time study and rate setting all the while, develops a skill in dealing with such problems that cannot possibly be attained by someone who deals with them only once a month. A man who specializes in setting up punch presses or screw machines attains a proficiency that enables him to diagnose and remedy trouble far quicker than the man who sets up and also operates.

The principle of subdivision of labor has been most effectively applied in repetitive assembly work. Suppose we have a unit assembly which takes one man 2 hours to complete. We expect to make 10,000 units, which means 20,000 man-hours of assembly. We could increase the production per person and require less floor space if we: (1) Broke the 2 hours per unit down into a series of subassemblies; (2) set up a progressive assembly line, with a series of short cycle elements assigned to each station (we might have 20 stations on the line); (3) adopted a combination of (1) and (2).

As a matter of fact, any reasonably repetitive operation that does not make use of one of these three plans is definitely open to question regarding its effectiveness.

Suppose you decide to recommend plan (2), and you are told to go ahead. First let us look at the advantages, and then at the things we must do to make it an effective unit:

1. The shorter the cycle (that is, the time required to perform the elements or steps at a station) the easier it is to train new men. There are fewer things for the new man to learn. In the example above, instead of operations taking 2 hours we now break the assembly down into, say, 20 subassemblies, each one requiring only 5 minutes to complete.

2. Subdivision of labor increases the output per person, because it saves handling time, or time lost changing from one sequence of operations to the next.

3. It increases the output per square foot of floor space, because it reduces storage requirements as well as work in process.

Some companies do not get the most effective results from progressive assembly lines because they ignore some or all of the following necessary fundamentals:

1. The length of the cycle time should be carefully determined. It may vary from say 0.30 minute up to 15 or 20 minutes. Remember, the shorter the cycle, the greater the proficiency that can be attained, within

reasonable limits. The determining factors are the total hours required per unit, the quantity to be made, the length of the line, and the floor space.

2. The work assigned to every station should be determined by time study and care taken to *balance the cycle time at every station*. Every station must have approximately the same length of time. Do not leave this to the men on the line. Get the methods department to work up standard breakdowns for each product to go down the line. Post them near the line. The output of the line can be no greater than that of the station with the longest cycle time.

3. All air or hand tools should have a definite place, mounted overhead if possible, so that they can be instantly grasped or laid down without groping.

4. Materials should be arranged about the workplace or station to eliminate every unnecessary motion.

5. Deliveries of materials to lines must be made on exact schedules.

6. Production difficulties are much more serious on highly subdivided lines.

7. Adequate supervision must always be provided.

8. Holding fixtures should be provided where possible to free the hands for productive work.

9. Workplaces should be at the right height to permit employees to stand or sit at work.

Workplaces

In every factory many hand operations are done at a bench. Such operations include light assembly work, inspection, counting, packing. The carpenter shop was originally told to build a bench 34 or 36 inches high and so many feet long. Probably nobody has paid any attention to that workplace since. The result is that these operations are crude, disorderly, and inefficient. No thought has been given to the best arrangement of parts, economy of motion, proper heights of workplaces, and chairs for employees of different heights.

Contrast this type of workplace with one where every consideration has been given to comfort of employees, ease of operation, elimination of wasted effort or motions. Take a look at any such workplace in your department, and see if you cannot improve it.

Purchase of New Equipment

As you analyze the jobs in your department, checking them against the points outlined in this chapter, you will find places where you think you could increase output or improve quality if the company would buy new equipment. It might be a machine, tool, die, jig, fixture, crane, or hoist. You talk with your superior, and tell him you think it would be a good idea if the company would buy it. Nothing happens. You do not hear any more from it. So you conclude there is not much use in trying to make suggestions.

One of the chief reasons why a recommendation made like this gets so little attention, is that you do not present it in a way to get attention. Top management has to know three things:

1. What will it cost?

2. How much will it save?

3. How long will it take to pay for itself?

Next time you have a suggestion or recommendation that involves the possible purchase of equipment, write up a short, simple statement using the following outline:

A. Present Method

1. Tell briefly how we do the job at the present time.

2. What are its disadvantages?

B. Proposed Method

1. Tell briefly how you propose to do the job.

2. What are the advantages over the present method? Will it increase production? Improve quality? Make the job easier? Make working conditions better?

3. Tell why you think the proposed method will work.

C. Cost of Proposed Method

1. What would the original cost of the equipment be?

2. What would the upkeep be (repairs, depreciation)?

D. Comparative Costs

1. What is the present direct labor cost per unit?

2. What do you think it would be under the new method?

3. About how many units do we turn out in a year?

4. Multiplying the savings per unit by the production per year, what would the annual savings be?

5. How long would it take, at that rate, to pay for the new equipment?

You may be surprised yourself when you analyze the idea this way. Perhaps it will take too long to pay for iself. Do not think you have to write up any elaborate report. This will all go on two typed pages. Ask the cost and time study or methods departments to help you prepare the data. Let them work up the figures for you. Talk over the report with your superior and see how much more attention it will get when you base your proposal on *facts* instead of hunches.

Working Conditions

Although improving working conditions does not logically belong in a chapter on methods, nevertheless every foreman should be concerned about the working conditions on every job in his department. It pays to create good working conditions. First, they promote satisfaction. When management concerns itself with the lighting, ventilation, reduction of fumes, heat, noise, it is concrete evidence to the men that management cares, and that it wants to make the plant a good place to work in. Second, good working conditions keep down costs. You never saw a job with poor working conditions where output was not adversely affected by those conditions. Third, good working conditions reduce defective work and accidents.

Look over every one of your jobs and check them against the following points:

1. Is the lighting adequate?

2. Is the workplace the right height so that there is no uncomfortable or inefficient posture?

3. Are any of these factors present to a degree which makes the job disagreeable: Dust, fumes, heat, lifting, noise, wet?

4. What can be done to minimize any of these factors?

When you improve working conditions you increase output.

Personnel Problems

We have already pointed out that we all dislike change. Once we have established our daily routines, we do not like anything that requires us to change them. And we particularly dislike any new thing that is sprung on us on short notice. Suppose you came in on Monday morning and found that, over the weekend, the plant engineer had relocated 8 or 10 machines in your department, without even discussing it with you. You know how you would react. Suppose now you were a machine operator; you came in some morning and found

they had moved your machine (for of course you think of it as "yours"). What would be your reaction? It would be exactly the same in both instances. *Somebody changed something without telling you in advance.* That leads to the first fundamental principle in dealing with the personnel problems that come up when we make changes. This is very important:

1. Persons affected should be told of proposed changes in advance of the actual making of such changes, with reasons why, and what we hope to do.

Even though we go over a proposed new layout, machine, or method carefully, there is always the possibility something was overlooked that keeps the change from really clicking at first. The more different points of view we can get on the change, the less the possibility of overlooking something. Moreover, it appeals to everyone's job pride and self-respect to feel his opinion has been asked in advance, even if he had nothing to offer. Such a policy definitely builds good will and interest, which leads us to the second fundamental principle.

2. Everyone affected by a change should not only be told in advance, but criticisms and suggestions should also be solicited before the change is actually made.

Rarely, if ever, is any change in methods made without some "growing pains." There is always a stage of development where things do not go right. Schedules cannot be maintained, material fails to give satisfactory results, and in general there is a lot of "grief." These conditions involve two more principles:

3. Employees should not be permitted to fall below their previous average hourly earnings (where piecework or bonus is involved) during such development stages because, through no fault of theirs, conditions are not right.

4. Additional supervision should be allowed for during the development stage, to minimize operating troubles and act quickly when they occur.

Sometimes the new method requires fewer employees than the old one did. This raises another fundamental principle:

5. Normal labor turnover should be depended on to take care of reductions in the force that might grow out of changed methods.

Staff Department Relations

Some time ago a staff man (the chemist) in a plant was asked to describe his duties. One question was "what is the most difficult job in your department?" The idea of the question was to bring out the most responsible job under his supervision. But he misunderstood and wrote:

"Convincing the foremen that my way is better than theirs."

Unfortunately, there is too much of that feeling between foremen and staff men. The staff man is there to help the foreman do a better job. Regardless of what you think of the staff men in your plant, if you are really interested in improving your methods, by all means enlist the assistance of all the staff departments. Put your problems up to them, get them to work with you. Do not be too much concerned about who gets the credit. Working with the staff departments, you can reduce costs, which is one of your major responsibilities. The foreman who learns to use staff departments to help him solve his problems, is going to make a better showing than the one who looks on these departments as "intruders" or "impractical theorists."

Conclusion

While the foreman's primary responsibility is to get the work out on time, he should always be concerned about his costs. The best way to reduce costs is to improve methods. Reductions in cost through improved methods come from the more effective use of floor space, machines, and men, and from the elimination of wasted time and effort. The reason some plants are not more efficient is because of complacency, indifference, inertia, and a lack of knowledge regarding the best practices in progressive plants. Recognize your responsibility for improving methods, be receptive to new ideas, follow developments in your industry through trade journals, spend some time in constructive thinking. Keep constantly before you an appreciation of the fact that *change is the very essence of good management.*

II. Planning Production

THE UNUM COMPANY IS ALL SET to place an order for two of our new Type M machines, if the delivery date is right. How soon can you give us two?" The sales manager of the Seneca Company, full of that enthusiasm which every good sales manager has to have, was talking to the production manager. The production manager looked in his little black book, made a few figures on a pad and said, "Eight weeks."

The Unum Company placed its order on the basis of eight weeks for delivery. Eight, ten, twelve weeks rolled by, and still the Type M machines were held up on the assembly floor. Now what was wrong? Was the shop at fault? Did some foreman fall down on his job? How did it happen that an order, promised in eight weeks, was still on the floor after twelve weeks?

The real difficulty lay in the fact that the production manager always promised delivery of every order in eight weeks, without any attempt to analyze an order in terms of man or machine hours to see what it meant to the shop. As a matter of fact, he did not even have any information about how long it would take in every department. His promise of eight weeks was just a guess. A guess that resulted in a dissatisfied customer and placed the production department on the spot, because everybody thought it had fallen down on the job. Actually the two machines could not possibly have been made in eight weeks.

This sort of thing happens all the time. Delivery dates or production schedules are not met because someone fails to take into account all the facts, or fails to do a good production planning job.

Every foreman has to be interested in production planning because one of his major responsibilities is to get the day's work out on time. If he fails to do this, he fails as a foreman. Of course, this presupposes that we know what the day's work is, and just what "on time" means. The foreman cannot do anything about it unless he has a definite schedule to go by. Somebody has to say, "We want so many of this and that, on such and such dates," and these requirements must be within the capacity of the plant.

The problem of production planning depends somewhat on the type and kind of products and operations. One company may make standardized products in large quantities. Production planning is built around a daily or weekly schedule for the assembly department. Another company may make "tailor-made" products, as in a job shop, where only one or two of a kind are made at any one time. Still another company may be in a

processing industry, such as chemicals. Or may make for stock or on customer's order only.

Regardless of the products or processes, there are certain simple, basic things that must be determined somewhere by someone:

1. *What* is to be made.
2. *How* it is to be made.
3. *When* it is to be made.
4. *What* materials are needed.
5. *How* it shall be scheduled.

If there is a planning department, most of these tasks will be done by it. If there is none, then various persons may have a part in them.

What Is to Be Made and When

The customer wants what he wants when he wants it. All planning must start with that simple idea. We must meet the customer's demands, particularly if we promised certain delivery dates. In planning *what* and *when*, we must consider:

1. What are the delivery dates?

2. Can we combine any orders to reduce set-ups?

3. Can we make certain standard parts or subassemblies for stock? While this reduces costs and speeds up deliveries, care must be taken to avoid building up too much stock.

4. Have we any bottlenecks along the line? A bottleneck is the operation that takes the longest time, so we can produce no more than will pass that operation in a stated time.

5. Are we to make to stock, on order, or both?

6. What rate of production or what combinations (in terms of units per day or week) will give the most efficient manufacture and the most stable employment?

7. Are we fully equipped to make a line (tooling, fixtures, etc.)?

This task of planning the manufacturing schedule has to be done by someone who knows the requirements of the sales department. Quite clearly the manufacturing schedule must be planned for the plant as a whole, since we could not bring together the right parts at the right time in the assembly department, if every department made what it thought ought to be made. So the results of this production planning are usually expressed in terms of either (1) a manufacturing schedule (usually daily or weekly) that specifies exactly what is to be assembled on a given day or in a given week; (2) a series of manufacturing orders that are released to the shop from time to time, with specified delivery dates.

The first type of schedule is more applicable to standardized, so-called "mass production" products, and the latter to "tailor-made" products. In either case, they both become the basis for all production planning.

How It Is to Be Made

Before a product is released for production, someone has to determine how it is to be made. This is usually called routing.

In other words, someone takes a look at the part, sample, or drawing, and decides the exact operations that must be done to make the part, the best sequence in which to do them, on what machines, and whether jigs, fixtures, gages are to be provided. They may even estimate the approximate times, and specify speeds and feeds.

All this is definitely part of production planning since it means that no orders are put in the works until we know how the product is to be made, and whether the tools and equipment are available. It may be necessary to make models or samples.

In a well-managed plant there will be route or operation sheets showing: (a) part number, (b) sequence of operations, (c) tooling, jigs, fixtures, (d) type of machines, (e) speeds and feeds, (f) estimated times.

There must be records of this kind, because it is unwise to leave these things to someone's memory.

For example, in addition to maintaining complete route sheets on all its products, one company uses a tool record card also. One of these cards is prepared for each operation, and goes to the tool crib, so that all the tools for the operation can be assembled in advance, and held ready until the man who is to perform that operation calls for them. This card shows the name of the tool, the symbol, the section, box, shelf, rack, block, or pan in which it will be found, together with the number of the toolroom or crib. In this way, there is no waiting at the window while someone tries to find some tools, or time lost because the tools are not all there when the man is ready to start the job.

Materials Planning

Another necessary step is to make sure that we either have all the material, or else order it so that it will be on hand when we need it. It only makes trouble when we start an order and do not have some necessary material item.

The usual practice is to work up bills of materials showing kind and quantity of materials required per unit. Then, by taking the manufacturing schedule and multiplying the number of units by the quantity per unit (including necessary scrap allowances), we can easily compute the materials requirements.

Usually some kind of perpetual inventory of raw materials must be kept, to maintain control over stores. Just as the customer wants what he wants when he wants it, so does the manufacturing department, when it comes to raw materials.

Scheduling Work

Once we have decided what is to be made, when it is to be finished, what operations and methods are to be used, and when and where materials are coming from, we arrive at the problem of scheduling work to lines, machines, or workplaces. In other words, we now have to assign jobs to men or machines.

The foreman plays a most important part at this point, because he may be wholly responsible for the assignment of work in his department. The problem of scheduling depends on whether the plant works from a manufacturing schedule or from a series of orders released from time to time.

Manufacturing Schedules

If there is a daily or weekly manufacturing schedule, it is usually made up for the assembly department. Such a schedule generally carries with it a definite assignment of work, either to lines, groups, or individuals in the assembly department, and is based on an over-all cycle of so many days in process. There may be secondary schedules for key operations in other departments.

Here, two steps are necessary:

1. Draw up "timetables" showing just when it is necessary to start all preparatory operations in order to deliver the parts to the assembly department at the right time.

2. Translate the daily schedule into terms of what it takes in materials and man or machine hours in the preparatory operations or departments.

For example, if a part is to be forged, machined, and heat-treated, how far ahead of assembly must the first operation be started? How many pieces are required for the quantity scheduled for assembly? Either the foreman or the planning department must analyze the master schedule and work out the answers to these questions. Unless somebody does it regularly and systematically, there

will be delays and shortages all along the line. These things cannot be left to chance.

Manufacturing Orders

In contrast to the daily or weekly schedule for the assembly department, it is the usual practice in job shops to release orders to the shop from time to time, with specified delivery dates. Basically, the same steps are required. There are some differences:

A. Where the daily or weekly schedule is used (generally on high production items),

1. Great care is taken to balance all operations to avoid bottlenecks.

2. Timetables or schedules for preparatory operations are much tighter, since work in process is held to a minimum.

3. Timetables are quite definitely fixed, as to when work is due out of the various departments.

B. With the manufacturing order set-up it is necessary,

1. To build up machine hour loads, at least on key or bottleneck operations, since it is not possible to balance operations. Unless this is done, we may overload some departments.

2. Timetables are even more important than under the daily schedule system although they are not as tight. The part that will take the longest time must be started first and far enough ahead to be sure it reaches subassemblies or assemblies on time.

3. Particular care must be taken to break down the order in terms of materials requirements (working from a bill of materials) so that all materials may be ordered to meet the timetable.

The daily or weekly schedule involves what might be termed "recurrent planning" in that the same products recur or "come back again" repeatedly. The manufacturing order used in the job shop involves "non-recurrent planning" since the same product may not be made again for some time, if ever.

Tracing or Expediting Work

Suppose the Unum Company telegraphs, "Wire when we may expect delivery our order nine one nine." Someone has to check up on just where we stand on the order, and say exactly when shipment will be made. Of course, the well-managed plant never waits until the customer wires in about an order to check its progress. Someone (usually the planning department) is constantly checking the progress of work through the plant to make sure delivery promises are going to be met.

Again, this tracing or expediting is of less importance with the daily or weekly schedule. Once an order gets on this schedule, it has to come through (unless it is held back because of defective workmanship), because we are working on a fixed cycle of so many days in process, and we know what to assemble every day.

With the manufacturing order in the job shop, however, weeks or months may elapse before final assembly takes place. Obviously, the progress of work must be traced or expedited, if we are to have any assurance that timetables are being met.

There are really only two ways of tracing or expediting work. One is to get a man usually known as expediter or shop tracer and assign to him the task of checking the progress of orders. This is done by going from department to department daily, and seeing where each job stands.

The second, and more basic method, where there is a planning department, is to schedule the work, make up a job time ticket, and then use the job time ticket, after it has been returned from the shop showing it has been completed, to post the progress of work on a chart or bulletin board. Thus it is possible at all times to know just where every job stands.

However it may be done, tracing work through the shop is a function that should not be overlooked.

The Foreman's Part

The responsibilities of the foreman for production planning differ, depending on the extent to which these functions of planning, routing, material control, scheduling, and tracing are done by a planning department. Whatever the set-up may be, the foreman has a definite part to play.

If there is a planning department:

1. Work with it in every possible way. Look on it as something that can make your job easier.

2. Watch the manufacturing schedule carefully. Always know what is expected from your department.

3. Study your operations for bottlenecks. See that the planning department knows the limitations of your department.

4. Watch the number of set-ups. Tell the planning department if the schedules call for too frequent set-ups. Check with them, on any long set-up, to see if additional parts can be made for stock before tearing down.

5. Watch your spoilage or re-operation. When a part is spoiled, see that it is re-ordered. Advise promptly of any shortages.

6. Notify the planning department and your superior at once when you think you cannot meet the schedule.

7. If the manufacturing schedule is based on an over-all time, such as seven days from the time the first operation is started until the product is completed, work out a timetable for your own department, so you know when you must start and finish your operations to meet the schedule. Some jobs may have to be started the first day, others the second day, and so on.

8. Be sure the basic schedule gives you time enough to complete your operations. See that the planning department always understands your problems in this connection.

If there is no planning department:

1. Do not pick your promises out of the air. When you promise a job in a stated time, analyze it, and estimate the number of man or machine hours involved. The surest way to put yourself on the spot is to promise a date that is based only on a hunch.

2. Work up some kind of schedule for your own department. Take the orders as you receive them. Estimate, however roughly, the number of man or machine hours by operations. Build up machine loads. In other words, know at all times how many hours of work you have ahead, by machines.

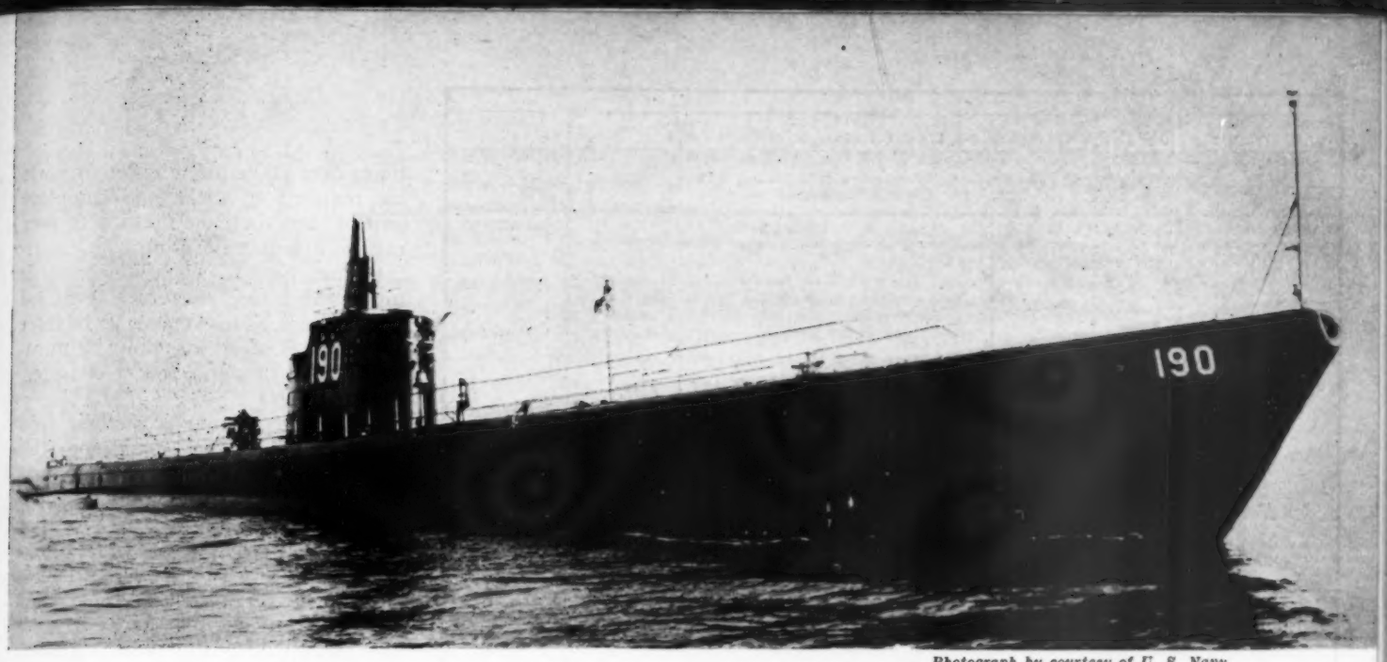
3. If you are asked to give some job preference over others to rush it through, get someone higher up to say what the order of work shall be.

4. Know where every order stands *all the time*, while it is in your department.

5. Contact the foremen in the departments ahead of yours and following yours, from time to time, and talk over the progress of jobs.

6. Work up your own departmental route sheets so that if you are out, someone else will know what operations are to be done.

Finally, use overtime sparingly. So that top management will understand your planning problems, make your requirements regarding men, materials, and equipment quite clear. Above all, when you find yourself getting in a hole, if you cannot see your way out, ask for assistance from your superior at once. Do not wait until you are so far behind schedule that it needs "all the King's horses and all the King's men" to put you back again.



Photograph by courtesy of U. S. Navy

Efficient, simplified production control system solves the problem of building ten submarines, one at a time

Production Control in Building Subs

Shipyard, first to build submarines on the Great Lakes, devises production control plan that gets things moving, keeps things moving, avoids waste of time and duplication of effort, and eliminates most of the foreman's paperwork

A. N. DEDRICKS, Production Engineer, Manitowoc Ship Building Company, Manitowoc, Wis.

UNCLE WANTS HIS BOATS is the slogan used at the Manitowoc Ship Building Company. It is brief and right to the point. We find it means: Eliminate all possible waste of time or duplication of effort, eliminate bottlenecks, get things moving and keep them moving, and produce Uncle Sam's boats in the quickest and best way possible.

The answer to all this is an efficient, simplified production control system that will deal with the problem of building ten boats, built one at a time, and produce them when and how they are wanted.

This article covers the system used to produce the hull of the submarine, which is the structural part of the boat, minus machinery and equipment.

In September, 1940, the government placed an order with us for ten submarines. The Navy Yards at Mare Island and Portsmouth, and the Electric Boat Company of Groton, Conn., are the only shipyards that have built any of the recent submarines for the U. S. Navy. The order to the Manitowoc Yards is the first order for submarines ever to be placed with any shipyard on the Great Lakes.

A submarine is considered one of the most complicated boats to build. Precision, quality of workmanship, ability to produce promptly, require first-class machining, and mechanics of all trades to do the job. Manitowoc has built many boats, but a submarine was new and different, and something that could not be built from memory or past history.

The problem looked like this:

1. About 2,000 (more or less) blueprints are required in the building of submarines.

2. All information for the entering of orders to the various shops must be taken from these blueprints.

3. To build one hull complete requires about 4,000 orders, telling what to do, how to do it, and what material to use.

4. Orders average about 160 five-letter words, or an average one-page business letter.

5. Building ten boats meant that each order would have to be reproduced ten times.

6. The system would have to be flexible enough to control the production in at least twelve different departments, located in various parts of the yards, each department doing a different class of work.

7. Because of the enormous amount of work necessary, each foreman would have larger crews, composed mainly of apprentices and learners rather than skilled mechanics. This meant he would have to devote more time to his help, and be more specific in giving them instructions.

The first consideration was how to describe the various pieces on the orders, so each part could be identified easily and quickly. Some blueprints were over 12 feet long. Some-

CONTRACT NO.	JOB NO	TITLE	PLAN NO
1001	25	M.B.T. 4-A & 4-B F.V. Seat Fr.70-72-74 P & S	2255-17
ORDER NO.	DATE ISSUED	SEND COPIES TO THE FOLLOWING DEPARTMENTS	DRAWING DATE
5517	2/20/41	R. West, A. Steel, Graphcut, Plate, Fitters Weld & Blacksmith	11/30/40
QUANTITY	SHEET		MEMO NO.
3-P+3S	1 OF 1		1001

PERFORMANCE START	FINISH	DEPARTMENT	DESCRIPTION	DELIVER TO
3/24	3/25	Fitters	Mark Plate F.V.S.-1 for Length of Flood Valve Seats so that Graphcut can Cut to Length and Plate Shop can Plane Butt Joints to Shape. Use 51.0# PLATE #FVS-1.	Graphcut
3/25	3/26	Graphcut	Cut Plate FVS-1 (Fitters will Mark) to Length only	Plate
3/26	3/27	Plate	Plate Both Ends of Plate to make Butt Joints of Flood Valve Seats per Blueprint.	Graphcut
3/27	3/31	Graphcut	Cut Valve Seats Item B-3 Marked #1. Allow 1/8" Stock on Shell Edge.	Plate
3/31	4/3	Plate	Flame Bevel Bottom Edge of Item B-3 Marked #1 and then straighten Seats.	Machine
4/3	4/9	Machine	Machine Seat Edge of Seats.	Plate
4/9	4/11	Plate	Roll Seats to Shape to Accurately Fit Welding Jig.	Weld
4/11	4/16	Weld	Assemble & Weld Hinge Lugs and Weld Butt using Jig. Grind or Clean up Butt.	Black-smith
4/16	4/18	Black-smith	Stress Relieve Seat.	Weld
4/18	4/22	Weld	Apply Composition Weld to Seat.	Machine
	3/24	Material Stores	1-51.0# Plate F.V.S.-1	Fitters

DELIVERY TICKET THIS TICKET MUST REMAIN WITH MATERIAL DELIVERED

CONTRACT NO.	JOB NO.	TITLE	PLAN NO.
1001	25	M.B.T. 4-A & 4-B F.V. Seat Fr.70-72-74 P & S	2255-17
ORDER NO.	DATE ISSUED	SEND COPIES TO THE FOLLOWING DEPARTMENTS	DRAWING DATE
5517	2/20/41	R. West, A. Steel, Graphcut, Plate, Fitters, Weld & Blacksmith	11/30/40
QUANTITY	SHEET		MEMO NO.
3-P+3S	1 OF 1		1001

PERFORMANCE START	FINISH	DEPARTMENT	DESCRIPTION	DELIVER TO
3/31	4/3	Plate	Flame Bevel Bottom Edge of Item B-3 Marked #1 and then straighten Seats.	Machine

FOLLOW-UP CARD

CONTRACT NO.	JOB NO.	TITLE	PLAN NO.
1001	25	M.B.T. 4-A & 4-B F.V. Seat Fr.70-72-74 P & S	2255-17
ORDER NO.	DATE ISSUED	SEND COPIES TO THE FOLLOWING DEPARTMENTS	DRAWING DATE
5517	2/20/41	R. West, A. Steel, Graphcut, Plate, Fitters, Weld & Blacksmith	11/30/40
QUANTITY	SHEET		MEMO NO.
3-P+3S	1 OF 1		1001

PERFORMANCE START	FINISH	DEPARTMENT	DESCRIPTION	DELIVER TO
3/24	3/25	Fitters	Mark Plate F.V.S.-1 for Length of Flood Valve Seats so that Graphcut can Cut to Length and Plate Shop can Plane Butt Joints to Shape. Use 51.0# PLATE	

WORK ORDER

CONTRACT NO.	JOB NO.	TITLE	PLAN NO.
1001	25	M.B.T. 4-A & 4-B F.V. Seat Fr.70-72-74 P & S	2255-17
ORDER NO.	DATE ISSUED	SEND COPIES TO THE FOLLOWING DEPARTMENTS	DRAWING DATE
5517	2/20/41	R. West, A. Steel, Graphcut, Plate, Fitters, Weld & Blacksmith	11/30/40
QUANTITY	SHEET		MEMO NO.
3-P+3S	1 OF 1		1001

PERFORMANCE START	FINISH	DEPARTMENT	DESCRIPTION	DELIVER TO
3/24	3/25	Fitters	Mark Plate F.V.S.-1 for Length of Flood Valve Seats so that Graphcut can Cut to Length and Plate Shop can Plane Butt Joints to Shape. Use 51.0# PLATE #FVS-1.	Graphcut

MATERIAL REQUISITION

CONTRACT NO.	JOB NO.	TITLE	PLAN NO.
1001	25	M.B.T. 4-A & 4-B F.V. Seat Fr.70-72-74 P & S	2255-17
ORDER NO.	DATE ISSUED	SEND COPIES TO THE FOLLOWING DEPARTMENTS	DRAWING DATE
5517	2/20/41	R. West, A. Steel, Graphcut, Plate, Fitters, Weld & Blacksmith	11/30/40
QUANTITY	SHEET		MEMO NO.
3-P+3S	1 OF 1		1001

PERFORMANCE START	FINISH	DEPARTMENT	DESCRIPTION	DELIVER TO
	3/24	Material Stores	1-51.0# Plate F.V.S.-1	Fitters

From the master order form (top) copies of work orders, follow-up cards, cards, delivery tickets, and material requisitions are drawn off by a duplicating machine. Standard orders for all ten boats can be made at one time, saving much time and lessening the chance for clerical errors

times over 200 entirely different parts are required to make one complete unit. It was therefore decided to give each different part a number, starting from No. 1. Each blueprint is numbered before any order is issued to the shops. This enables us to refer to the parts of an assembly by number, instead of name, saving considerable writing.

Now that a simple method had been arrived at for describing the various parts, the next question was the type of order that should be used. Here we had to consider the fact that about 4,000 orders would be required for each boat. Also, unless changes were made in procedure, the orders would be the same for each boat, with the exception of the order number, job number, and schedule dates. Therefore, we analyzed the order to ascertain what information would be constant and what would vary with re-issuing of orders for the other boats. Our order form was then laid out with all the "variable" information in a column on the left side of the form, requiring a space about 2 inches wide.

Master Copy for All Ten Boats

The form measures 8x10 inches and the balance, or 6x10 inches, carries information that does not change each time the order is re-issued. By using a duplicating machine, a master copy of the order is made that produces all the copies required for ten boats. Therefore, all that now is necessary in order to produce a new order for the next boat, is to use a strip of paper 2x10 inches on which to write the order number, job number, and schedule dates, which change with each order, and overlay this on the master copy.

As soon as blueprints are received, an order is immediately made out for the mold loft and steel templet departments. The loft is told what molds to make, when to have them finished, and to send them to either the steel templet department or to the ship fitters. If molds are sent to the templet department, this department also receives an order for making the steel templets needed for burning the steel to size. We wanted to be sure the mold loft (which is the initial department as far as the hull is concerned) made the molds in the order in which they would be needed. Thus, when an order is issued for the fabrication of the steel, the molds will be ready, and will not delay the start of the work. The number marked on the blueprint is painted on the molds and templets to identify them, and also make it easy for the department using them to mark this

same number on the actual material.

Next to be decided was the proper sequence of the various shops through which the material must pass. It now became necessary to break down the order into groups of parts that could follow the same sequence, to avoid unnecessary handling and to increase machine output. The orders would show which department was to work on the part, what it should do, and where to deliver it when finished.

Realizing, however, that a good foreman seldom is also a good clerk, we made an effort to reduce the foreman's clerical work to a minimum. If we told him to cut items 10-12-14-15, it still would be necessary for him to check the blueprints to ascertain the quantity. As long as we had to check and double-check the blueprints to make sure we had ordered everything, it didn't require much additional effort on our part to tell him to cut 2 pieces No. 10, 20 No. 12, 1 No. 14, and 6 No. 15.

He now knew how many of each item to cut, but he still would have to refer to the blueprint for the thickness and specifications of the steel, so we gave him this information also. Now all he has to do is get the material and go to work. To get the material a requisition on the materials stores is needed, showing where the material is to be used, how much is wanted, when it is wanted. We therefore put this information on our master copy so that a complete story of the entire assembly is available to the foreman. He can see at a glance what each department has to do, when it is to do it, and when the entire unit is to be completed.

No Relying on Memory

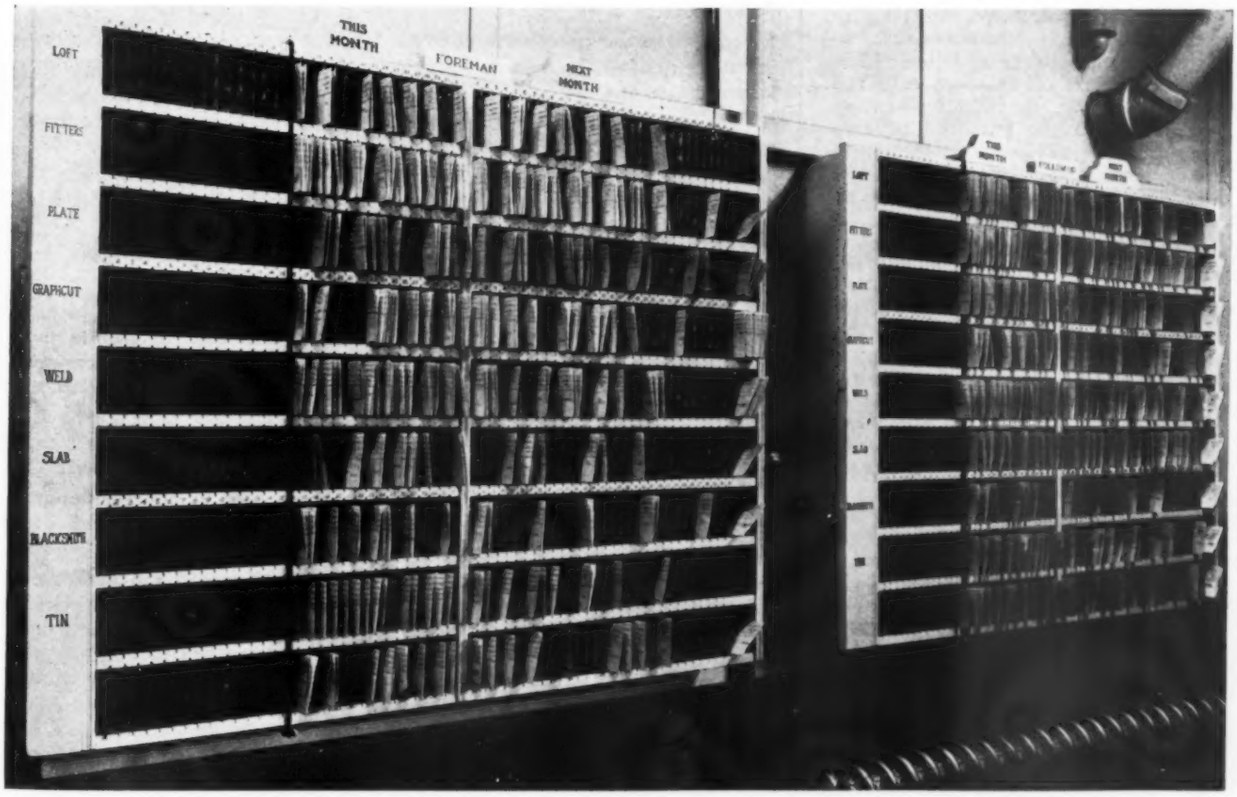
Another big problem remained. How was the foreman going to convey this information to his workmen? In anything as exacting as the building of a submarine, it would be foolhardy to tell the men to do this or that on a group of orders, and rely on them to remember everything they were told. Furthermore, working two or three shifts, the day foreman usually lines up the work for the other shifts, and the verbal method is dangerous.

Still another point, when parts for five boats are under construction in the shops a foreman has a great many active orders. To expect him to go through them and pick out the ones to be worked on according to schedule, would require much too much desk work, and too many chances for oversight, which would result in delay. And, most important of all, although the foreman is given an order that shows the complete picture of the unit, he is mainly interested in the one or two little paragraphs that tell him what his department is to do.

This last point seemed to answer the question. Why not give the foreman a work order which he can turn over to the workman? The card contains the heading as it appears on the regular order, plus the paragraph that covers the work in the foreman's department. The duplicating machine handles this work easily, with no additional writing.

Furthermore, whereas the original complete order is given the foreman at the time it is issued, the cards can be filed in a rack in the production office, and given the foreman the day before he starts the job. In this way it is unnecessary for the foreman to leaf through his orders every day, because he receives a small number of cards that mean jobs to be started. Each work order carries complete instructions regarding what to do and when to have it done. The foreman does not have to write out instructions to his men, but merely hands them the card, and can be assured his

(*Continued on page 160*)



Foreman's work orders are placed in the rack for the day on which the work is to be performed. Cards in the follow-up rack, duplicates of the work orders, show immediately when the schedule has gone wrong

MANAGEMENT SHORTS

Readers are invited to contribute brief articles, illustrated when possible, reporting out-of-the-ordinary management accomplishments. Accepted articles will be paid for

SEMI-MONTHLY TOOL SERVICE RECORD

Budget Cost per Unit..... Actual Cost per Unit..... Department No.....

Number Units Built..... Year..... Month.....

NAME OF TOOLS	COST	PART NUMBERS AND QUANTITY USED						TOTAL COST

Showing Foreman Tool Costs Helps Cut Costs

CHARLES E. O'CONNOR, Works Auditor, Tractor Works, J. I. Case Company, Racine, Wis.

Recently I glanced over the expenditures for our plant, which employs about 1,500 men, and the item that caught my eye, the item that had the largest amount of money involved, was small, hand, or perishable tools distributed by the tool cribs.

To reduce this figure and also to maintain a control for it, a form was drawn up showing the tools procured every two weeks and the cost of each tool. The catalog numbers of the parts machined with those tools, the quantity of tools given out, and the total cost of tools used were also included. At the top of the form was placed the estimated budget cost per unit of manufacture. For example, the unit for the automobile industry would be "per car" produced, for the radio business, "per radio." The actual cost per unit of manufacture was indicated next, for comparison with the estimated cost.

This form was made out and sent to each department affected, giving the foremen an opportunity to note simultaneously their budgets and the actual cost per unit of manufacture. These figures told them whether the trend was up or down in their respective departments.

On the basis of this actual cost per unit of manufacture, reports were made out showing in order the departments having the largest percentages of increased tool cost. The psychological purpose of these reports was to keep each foreman sufficiently cost conscious that he would make every attempt to cut tool costs, and thus prevent his department from taking a top position on the list.

The results of the introduction of this method of tool cost control were astounding. The fact that the foremen knew the cost of each item used was responsible for great tool savings. Even the men who operated the various machines where these tools were used knew exactly the cost of each new tool as they received it from the tool cribs. In turn, they took greater pains to reduce their tool costs.

What was the final outcome, one might ask? During a period of ten years, our company was able to realize through the use of this plan an estimated savings of $150,000 in tool costs, and it is very likely that this savings will continue to increase in the future.

•

Step Bar Eliminates Need for a Helper

DANIEL BERG, Bridgeport, Conn.

On one of our machines was an operating pedal at the right-hand side. This

(*Continued on page 168*)

Management, How Good Is Your Control?

Ask yourself these questions to check up

13. INTERDEPARTMENTAL VISITING

1. Are you regulating interdepartmental visiting in your plant? What control have you set up? Does it function smoothly?

2. Is there a great deal of traffic passing through from one department to another? Does it disrupt work? Have you done anything about it?

3. Do you allow employees to go freely from one department to another? Or have you designated a clearly marked contact desk or other space for the conduct of interdepartmental business?

4. Are there any set restrictions as to time? Purpose? Persons contacted?

5. Is there too much time spent waiting for work? Or are jobs that take a long time called for?

6. Does the visitor have to wait for contact with the head of the department? Is an effort made to contact him and determine the nature of his business? To help him? Or is he allowed to browse through and find what he can? Is he required to report to the department head before leaving?

7. Is a record kept of the time spent by employees visiting in other departments? Of the purpose of the visit? Of the person visited?

8. Do interdepartmental messengers know how to contact departments properly? Do timekeepers? Inspectors? Stock chasers? Is there any set routine for this?

9. Is a periodic check made on the miscellaneous movement of visiting personnel in and through departments? Have you checked on its necessity? Do you have department heads and supervisors check with one another? Do they submit any reports to you?

10. Are you doing defense work? Do your visiting regulations take that into consideration?

Next Month: Coordination With Night Crew

Prepared by HARDING PALMER, *Industrial Engineer*

Lockheed Aircraft Corporation, Burbank, Calif.

Tests Help You Hire Right

A good test saves dollars by eliminating mistakes before they're hired. And the principles used in working up the blueprint test described in this article are applicable to the construction of other types

R. W. GILLETTE, Personnel Manager, The Trane Company, LaCrosse, Wis.

TESTING APPLICANTS for employment is both exciting and profitable. With the government mobilizing skilled help as well as soldiers for national defense, industry is faced with the problem of selecting and training men from the unskilled classes to take care of expansion programs.

It is more important now than ever to evaluate the industrial achievements of the applicant. This evaluation may be based upon human judgment, but human judgment is subjective, and ten executives rating an individual would not be consistent in giving the applicant his proper rank. A combination of human judgment and employment tests is far better than either alone. Tests are objective; if properly constructed and administered, they rate applicants consistently.

Unfortunately, however, most tests which can be purchased on the open market are designed to reflect scholastic achievement rather than industrial achievement. So, if you want a test to fit your needs, it will be desirable to construct one. Like a cheap tool or dilapidated machine, a makeshift test gives poor results. A little extra time and effort will place in your hands a valuable instrument for measuring human abilities.

Basic Test Considerations

To begin with, we are interested in the effectiveness of a test in its ability to weed out below-par applicants. Also, we are interested in how much time and money it will take to give these tests. With an abundant unskilled labor market to choose from, we need something to aid us in hiring our help. The executive who talks to many people daily must find that his efficiency drops fast after the sixth consecutive interview. If it is possible to single out the poor prospects with a test, that leaves only the most promising to talk to.

In choosing a test it is not only desirable but also necessary to pick one that can be given to a large group simultaneously, one that costs little, and one that takes only a minute or two to score per test. The tests that best fit these requirements are those of the paper-and-pencil variety.

It is the purpose of this article to describe the construction of a trade or achievement test. This kind of test aims to help determine a person's degree of proficiency in a given occupation or field in which he has had some education or training. It differs from the recently popularized aptitude tests which aim to discover latent talent in a field where a person has had little or no education or training. For example, a musical aptitude test

Figure 1. The Trane Company weeds out below-par applicants with a simple blueprint test. Here, page 1 of test, with sample questions

Date_____ Score_____

TRANE COMPANY BLUEPRINT READING TEST

Read this page and follow directions carefully. Do not open examination until told to do so. Fill in the following blanks, giving your name, age, etc.

Name_____ Address_____
First Initial Last Name

Phone_____ Age last birthday_____ Total years education_____

Total years of mechanical experience_____

Amount of mechanical drawing taken in school (years)_____

Amount of mechanical drawing from job experience (years)_____

This examination contains two tests and corresponding blueprints. The blueprint of the wedge is to be used in answering questions on Test I. The blueprint of a right-hand end sheet is to be used in answering questions on Test II.

These tests contain questions of different kinds. Here is a sample question already answered correctly. Notice how it is answered: (Use blueprint of wedge)

EXAMPLE I:
What line in side view corresponds with line B in top view?.....(M)

The right answer is M and is written in parenthesis at end of dotted line.

EXAMPLE II:
The Wedge is drawn to what scale:

(1) 4" = 12" (2) 6" = 12" (3) 1" = 12" .....(2)

The right answer is 6" = 12" which is No. 2, and 2 is written in parenthesis at end of dotted line.

You will answer all questions either with a numeral or a capital letter in the parenthesis.

DO NOT TURN PAGE UNTIL TOLD TO DO SO

TEST I on the Wedge

This is a problem in simple projection. The letters are shown to make easy reference from one view to another.

Questions — Answers

1. What line in front view corresponds with line A in top view? ..... ( )
2. What line in side view corresponds with line L in front view? ..... ( )
3. What line in top view corresponds with line V in side view? ..... ( )
4. Surface S in top view is what?

   (1) sloping (2) vertical (3) level ..... ( )
5. Where is surface T shown in side view? ..... ( )
6. The dimensions of level surface S are:

   (1) 2" x 1" (2) 11/16" x 2" (3) 3 1/8" x 5/16" ..... ( )
7. The over-all dimensions are:

   (1) 3/4" x 2" x 4 1/8" (2) 1/8" x 2" x 3 1/8"
   (3) 5/16" x 3 1/8" x 3/4" ..... ( )
8. The dimension from line L to line J in front view is:

   (1) 2" (2) 3/4" (3) 5/8" (4) 1/8" ..... ( )
9. What is the material?

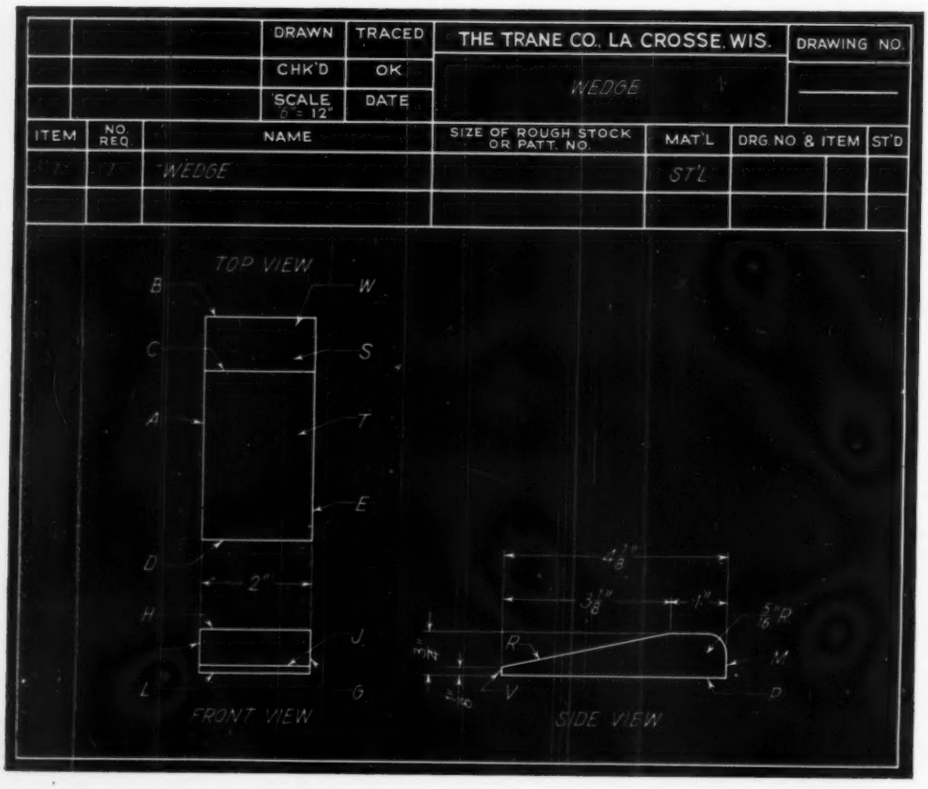
   (1) aluminum (2) steel (3) copper (4) brass ..... ( )
10. The dimensions of surface L shown in front view are:

    (1) 2" x 1/8" (2) 3 13/16" x 3/4" (3) 2" x 4 1/8" ..... ( )

When you finish Test I begin Test II immediately

Figure 2. Ten questions were worked out to cover blueprint shown below

Figure 3. Ability to read blueprints is a "must" in nearly all departments



is given a person who has not had any training in music. The purpose is to see if this individual will be successful in music if he or she studies it. Although this type of test would be very valuable to industry, its construction is so complicated and its results are so uncertain that it is best to leave it until skilled psychologists have perfected it.

A Typical Achievement Test

It does not take a skilled psychologist, however, to construct a good achievement test, and it is hoped that by describing a test of ability to read blueprints that has been developed here in The Trane Company we can point out the "musts" that go into making a test that works. A good test must be tested and pass certain requirements or standards.

We found in our shops that the ability to read blueprints was a necessary qualification in nearly every department. Most of the foremen's complaints about men were about those who could not follow a print. With the help of the chief designer, who, incidentally, had taught night school classes how to read blueprints, ten questions were therefore worked out to cover a simple print and twenty questions to cover a second print, somewhat more difficult to read. Figure 1 shows the first page of the test, with instructions and sample questions. See Figure 2 for the list of ten questions, Figure 3 for the simple print, Figure 4 for the second print, Figure 5 for the corresponding list of twenty questions.

Several hundred copies were printed on a duplicating machine. The test was given to a group of our own employees and some applicants. Several ambiguous questions and construction errors were discovered and had to be corrected. A simpler and more accurate scoring method was hit upon.

Time Limit Important

A time limit had to be set. While the original test was being written the first person to complete the test did it in 30 minutes. Later, 25 minutes was the time chosen to let all people write the test. It has been satisfactory, since in testing over 300 people so far no one has ever written a perfect score or a zero. Some of the questions were simple enough to allow everyone to make some score, and yet the questions were difficult enough to reach the height of everyone's ability in the allowed 25 minutes. To date, the highest score has been 98 and the lowest 3.

It is desirable but not absolutely necessary to arrange the questions in

order of difficulty. This can be done easily after the first trial test has been given. The question answered correctly by the largest number of people taking the test is probably the easiest to answer, and is therefore made the first question. The one correctly answered by the second largest number is the second on the list, and so on, until every question has its ranking place in the test.

Arranging the questions in order of difficulty has several purposes. Based on an assumption that the record made by the trial test group represents what the average man would do on writing the test, a man starting at the beginning on the easier questions would be able to reach the limit of his ability to answer the questions better than had he struck a more difficult one at the beginning, and wasted too much of the valuable allowed time. It is the aim of all good tests to help each person get the best possible score, not the worst possible score. We are testing how good he is, not how bad he is. Another purpose of this arrangement is that it sometimes helps to make a test that shows poor results the first run, turn out to be a more satisfactory test by giving a better distribution of the scores.

Distribution of Scores

After the first trial run we found, upon plotting the scores on a piece of graph paper, that the distribution of the scores looked good—that is, there was no large grouping of scores at any particular level. Most of the scores were around average, with a few approaching the highest and a few dwindling down to the lowest. Roughly speaking, about 40 percent of any set of test scores should be average, 20 percent better than average, and 10 percent in the highest bracket. Also, there should be about 20 percent below average, and 10 percent in the lowest bracket.

This conforms roughly to the "normal curve of distribution," which applies to all human traits. We find only a few very tall people per capita and only a few very short ones. Most of us are of average height. So with intelligence, beauty, ability to make money, industry, and thousands of other human traits. If in our test scores we find a distribution like that described above, we can assume we are getting a correct sampling of the population at large. In this way, we are measuring individual differences in that particular trait in which we are testing. If, in constructing our test, we had found that too many scores were high and grouped, we could have remedied it either by shortening

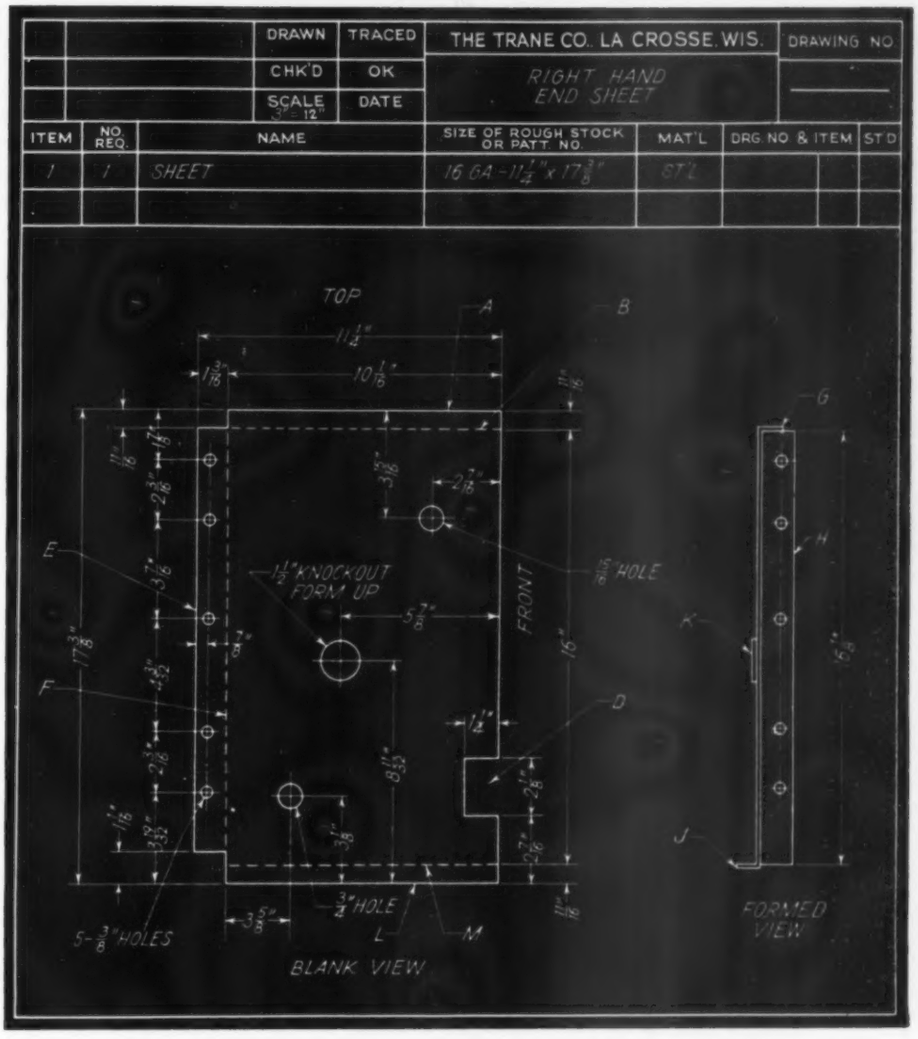


Figure 4. Second blueprint is far more difficult to read and questions are correspondingly harder for the applicant to answer

"MUSTS" FOR THE TEST MAKER

The technical terms used here are peculiar to test construction and are explained by easily understood examples in the text

1. Set a TIME LIMIT
2. Arrange questions in ORDER OF DIFFICULTY
3. Have normal SCORE DISTRIBUTION
4. VALIDATE the test
5. Insure the RELIABILITY of the test
6. Calculate the CRITICAL SCORE
7. TRANSMUTE the RAW SCORES
8. WEIGHT the questions
9. Gain OBJECTIVENESS
10. Make STATISTICAL ANALYSIS of the results

TEST II

Use Blueprint of "Right Hand End Sheet"

This is a problem in the usual type of sheet metal drawings used in The Trane Company shops. It involves some projection and some addition and subtraction.

Indicate your answers as you have done in Test I.

1. The over-all blank dimensions are:
   (1) 10 1/6" x 16" x 16 gage (2) 11 1/4" x 17 3/8" x 16 gage..... ( )
2. The material is:
   (1) copper (2) brass (3) steel ..... ( )
3. How many notches are there in blank view?
   (Enter the actual number counted as your answer)..... ( )
4. How many holes do you count in same view? ..... ( )
5. The vertical dimension from top of blank to 1st 3/8" hole from top is:
   (1) 1 7/8" (2) 2 7/16" (3) 3 15/16" ..... ( )
6. The vertical dimension from top of blank to 2nd 3/8" hole from top is:
   (1) 3 7/16" (2) 2 3/16" (3) 4 3/32" (4) 4 1/16" ..... ( )
7. The vertical dimension from top of blank to 4th 3/8" hole from top is:
   (1) 11 19/32" (2) 3 1/8" (3) 8 11/32" (4) 3 19/32" ..... ( )
8. The vertical dimension from bottom of blank to 1st 3/8" hole from bottom is:
   (1) 3 1/8" (2) 3 19/32" (3) 2 7/16" (4) 1 1/16" ..... ( )
9. The vertical dimension from bottom of blank to 3rd 3/8" hole from bottom is:
   (1) 7/16" (2) 9 7/8" (3) 4 3/32" (4) 3 7/16" ..... ( )
10. The vertical dimension from bottom of bank to 15/16" hole is:
    (1) 13 7/16" (2) 8 11/32" (3) 3 15/16" (4) 2 7/16" ..... ( )
11. The vertical dimension from top of blank to 1 1/2" knockout is:
    (1) 8 11/32" (2) 3 19/32" (3) 9 1/32" (4) 5 3/8" ..... ( )
12. Where is 1 1/2" knockout shown in formed view? ..... ( )
13. Where is line E in blank shown in formed view? ..... ( )
14. Where is line L in blank shown in formed view? ..... ( )
15. Would you form up or down along line F?
    (1) up (2) down..... ( )
16. Would you form up or down along line B?
    (1) up (2) down..... ( )
17. Would you form up or down along line M?
    (1) up (2) down..... ( )
18. How far is it from the top of blank to beginning of 2 1/8" notch?
    (1) 16" (2) 2 7/16" (3) 12 13/16" (4) 1 1/4" ..... ( )
19. What is the horizontal dimension from back of blank to 15/16" hole?
    (1) 8 13/16" (2) 2 7/16" (3) 3 15/16" (4) 10 1/6" ..... ( )
20. What is the horizontal dimension from back of blank to 1 1/2" knockout?
    (1) 3 5/8" (2) 5 1/2" (3) 2 3/4" (4) 5 3/8" ..... ( )

IF YOU FINISH BEFORE TIME IS CALLED, LOOK OVER THE TESTS AGAIN FOR POSSIBLE ERRORS

Figure 5. The twenty questions on the second print are a good bit harder to answer. All are answered by jotting down a numeral or letter

the time or by making some of the questions more difficult.

For several years classes in blueprint reading have been given at the La-Crosse Vocational and Adult School. Each class for two consecutive years was given our test. The people who had been attending this class should do well on such a test. We found the scores to have an even distribution from 30 to 98. No zeros and no hundreds! From testing such a small group the score plot will not produce an even curve as described above, but a good test will find scores at nearly every level.

Our scores showed a high correlation with the ranking given each pupil in the class by the instructor. This, too, is important because it shows the test is testing what it is supposed to test. Not who can make the most money, who is the best looking, who is the most intelligent, but who can read blueprints the best. This is called validating your test.

Retested at Random

Months later, people were retested at random, the same test being used. There was an improvement in the scores, but not more than 7 points. Seven points out of 100 is a negligible figure which could be charged to remembrance or practice. Theoretically we could say that each person hit his own level again on a retest, and that the test was reliable. Or, in other words, that each time it was used one could depend on getting accurate results. The reliability of a test can be bettered by lengthening it. This should not be done to extremes because the element of writing fatigue may void any good results. Employment tests should not run more than 30 minutes to be practical.

The scores from the blueprint reading classes were averaged; the average was 70.5, so we figured that 70 was a passing or critical score. Anything below 70 was unsuccessful so far as selection for employment was concerned. A lower score than this might prove satisfactory for all practical purposes, but only time and experimentation will tell.

If the labor market is plentiful, you can afford to be more stringent than if there is a scarcity. In view of the present scarcity, we can always lower our standards to fit the occasion. In finding 70.5 as the average score, which we chose to be the passing score, we were again fortunate in that 70 is more or less universally accepted as just passing. It is sometimes hard to explain to people not used to testing techniques that 50 on a certain

(Continued on page 162)

Figure 6. Scores are quickly computed by laying scoring stencil alongside answers. Stencil is simply a strip of cardboard with correct answers printed along edges. Correct answers to first set of questions count 2 points each; to second set of questions, 4 points each. Passing score is 70 points. Time allowed for test, 25 minutes

Test II, Page 3 Answers

2		3		3	7	1	4	1	2	2	1	3	K	H	J	2	2	1	3	1	4

Scoring Stencil for Blueprint Reading Test

(No. Right Test I x 2) + (No. Right Test II x 4) = Final Score

Norms		
Score	Qt.	Class
93 - 100	1	Excellent
85 - 92	2	Good
70 - 84	3	Fair
30 - 69	4	Poor

3		2		4		1		2		2	3		D	F	E

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FACTORY MANAGEMENT AND MAINTENANCE

McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42d STREET, NEW YORK, N. Y.

MAINTENANCE as the Editors See It

Let's Not Black-Out Defense Workers

MANUFACTURERS of industrial lighting equipment are having some difficulty, it is reported, in getting a sufficiently high priority rating to insure prompt procurement of needed materials. This situation should not be allowed to exist.

Rationing of raw materials imposes on those who are in charge of this activity the great responsibility of deciding the true value of countless products in relation to the defense program, and to the safety, health, and comfort of all civilians. It is to be expected that many honest mistakes and errors in judgment will be made. There is no excuse for mistakes in determining the importance of adequate and proper lighting, to the defense effort and to civilian welfare and morale as well.

Furthermore, just a little light isn't enough. To function efficiently and with minimum strain on the nervous system, the eyes must have plenty of light. That fact has repeatedly been proved, both in the laboratory and in the workshop. For many manufacturing operations the minimum recommended levels of illumination range from 100 to 200 foot-candles.

Then, too, in order to serve its purpose with maximum effectiveness, artificial light must be uniformly distributed, shadows and glare must be minimized.

This means that reflectors and fixtures must be properly engineered and skillfully made in a wide variety of designs, to meet many different requirements. And, as intensive research discloses new principles and facts, it is highly important that they be immediately translated into better designs of lighting equipment.

The nation's security, and the happiness and well being of its people are today largely dependent on the productiveness of the millions of workers who are laboring day and night in our industrial plants. In a wartime economy there are many things that we can get along without, but good lighting is not one of them.

Gearmotor Manufacturers Have Set a Fine Example

PARTICULARLY TIMELY, in view of the simplification programs being developed in cooperation with the U. S. Bureau of Standards and encouraged by the various government production committees, are the new standard speeds for gearmotors announced by the American Gear Manufacturers Association.

Not only working out standard speeds, but also finding a uniform method of rating so that differences of opinion on the reserve capacity required for given selections could be eliminated, were problems that faced the committee appointed to make this study.

A "Proposed Recommended Practice for Gearmotors" was therefore worked out, and adopted in October, 1940, by AGMA. At the same time the standard output speed program was adopted by National Electrical Manufacturers Association, which made it possible for AGMA to adopt this part of the program together with the rating practice.

The new standard output speed program was selected with a series factor of 1.225, using 1,750 rpm as the base. This means that the next lower speed is 1,750 divided by 1.225, or 1,430 rpm. The next is then obtained by dividing 1,430 by 1.225, and so on.

Almost all gearmotor manufacturers are cooperating in this new standard speed and recommended practice, which will make available a more standardized product, and by reducing inventories of necessary parts, insure better deliveries.

How Lighting and Paint Can Serve Defense

FAR LESS DANGER OF INJURY, and speedier production on machine tools are only two of several advantages claimed by two experimenters in a comparatively new color plus lighting technique. Here is a tool that anyone can use to lower the accident rate, speed up output, and encourage neatness and cleanliness of workplaces.

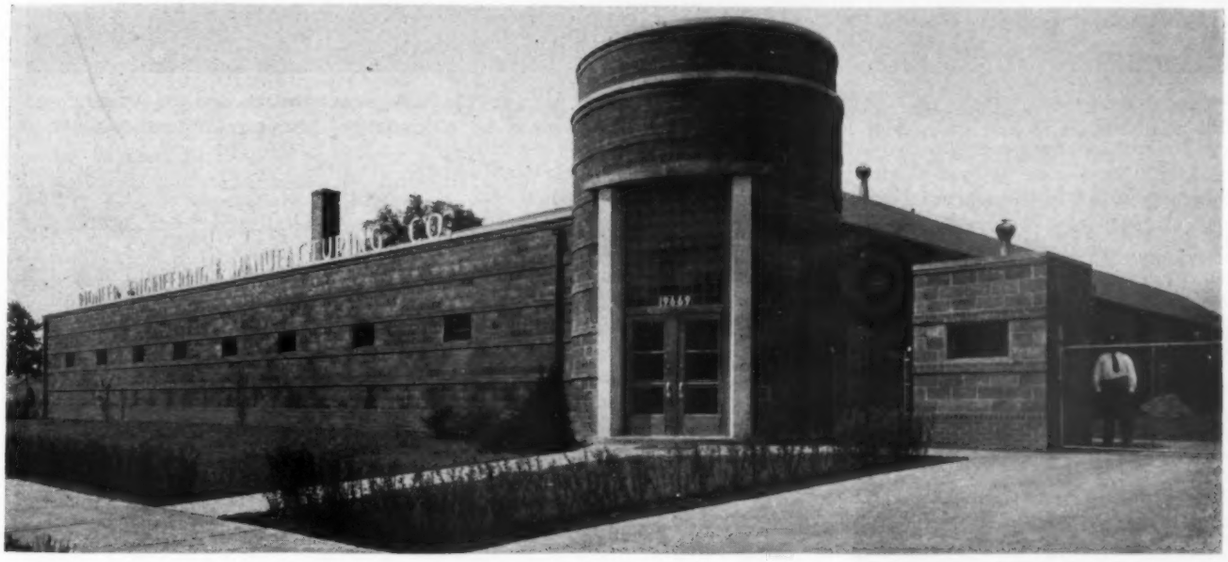
Most machines are painted a dull grey all over. Visibility at the actual working area is not too good. It is easier than it should be to get a finger between a cutter and the work; and more difficult than it should be to place work accurately in the machine. But, by the simple method of using two different colors of paint—medium grey for the body and light buff for the working area—together with the proper lighting, visibility increases immediately, danger decreases, and fumbling ceases.

This is the premise set forth by Arthur A. Brainerd, Philadelphia Electric Company, and Matt. Denning, E. I. duPont de Nemours, in a paper read before the Illuminating Engineering Society. It sounds reasonable, and the recommendations are not difficult to follow. As a matter of fact, work along this line was started back in 1932 (see *Factory and Industrial Management*, April, 1932), but it didn't get far. Now, when every means of speeding output should be used to the fullest, we hope to see further steps in this promising field.

Built to Foil the Saboteur

No chance here for enemies to stop or even delay production. Every precaution taken to keep vital information from getting into alien hands. This building was specially designed to keep data in and intruders out

A. M. SARGENT, President, The Pioneer Engineering & Manufacturing Company, Detroit



Only one entrance to Pioneer's plant—through the lobby, where a receptionist controls the doors to shop, offices, or drafting room. Windows are bombproof—and none can be opened. Guarded gateway is for deliveries only

OURS IS ONE OF THE FIRST factories to be constructed in accordance with defense recommendations of the FBI, the Army, and the Navy. Protection is especially necessary in our case, because the 23,000 square feet of floor space is devoted to specialized engineering services in the design of new machines, tools, dies, fixtures, gages, new methods, new processes. The amount of defense engineering work carried on means that we must insure not only continuous operation, but also that plans and drawings do not get into improper hands.

Because the nature of our work has always been highly confidential, plans for this type of building were begun some years ago. National defense merely intensified and made more urgent the need for adequate protection and control. The basic idea underlying all the special features to be described is simply this: We wanted a self-contained plant that we could operate all the time, despite attempts of would-be saboteurs to delay, or possibly halt, an important program or project. Also, there is the necessity for preventing information, in the form of drawings and data, being removed from the building.

Accumulating Recommendations

The first step in the development was the accumulation of all recommendations that would help in the accomplishment of this main purpose. Recommendations of FBI, Army, and Navy were secured, as well as the recommendations regarding sabotage sent to foremen by the National Foremen's Council. In addition, for employee comfort and satisfaction, we sent questionnaires to all our employees for ideas that they thought should be incorporated in the building. Accumulating and blending all this information took about six months. Erecting the building required only three months. However, time put into planning was well spent. There is a minimum of opportunity to get information out of the plant.

To begin with, the building is a shell and every partition can be moved at will without affecting the structure. Roof trusses are of bridge-like construction that permits free space, unimpeded by columns, throughout the 125-ft. wide building. These trusses rest on the 12-in. cinder block sidewalls, and a catwalk through them gives the only access to utilities, such as lights and telephone wires. Access to this catwalk is by ladder through

Drawings and specifications are filed overnight in safes with combination locks. Individual lockless lockers beside each man's desk eliminate the central locker room that could be a means of passing information outside

a hole cut in the 12-ft. suspended ceiling. Incidentally, this opening is placed in a conspicuous aisleway adjacent to the main row of offices and the ladder is kept under lock and key, which insures its use by authorized persons only.

A. M. Sargent served in various capacities at Burroughs Adding Machine Company, Studebaker Corporation, Chevrolet Motor Company. From 1924 to 1927 he was plant engineer and master mechanic of the C. G. Spring & Bumper Company; general manager of the Michigan Company, 1930-31. He joined Pioneer Engineering & Manufacturing Company 10 years ago. Several inventions stand to his credit, and he is the author of many technical articles

The original plan called for a windowless building with air conditioning and fluorescent lighting. But the possibility of complaints that the men could not tell the kind of weather outside, and concessions to claustrophobia, led to the use of single-pane windows, 2 feet square, placed 6 feet from the floor. These windows all have safety glass to guard against the penetration of fire bombs thrown from the outside.

No Windows Can Be Opened

These windows cannot be opened, and shutters are designed and installed to close easily over the inside panes in case a blackout may be necessary. Not only are these windows a guard against missiles from the outside, but also drawings cannot be passed out through toilet windows, or any others for that matter, nor can signals be readily passed from inside to outside.

An obvious way for saboteurs to cripple operation is to damage utilities controls placed outside or at floor levels of buildings. To avoid this possibility, all utility intakes come in overhead and are carried to a concrete vault under the building. There is only one access to this room—through a metal-covered door that is always locked. And there is only one key. It is impossible, therefore, for switches to be pulled to shut off power, for telephone lines to be tapped, for ventilation controls to be put out of commission, or, in fact, for any inside or outside tampering to interfere with essential services—unless the public utility is destroyed from outside the plant.

For the most part, tampering with these things comes from the inside. With the one key to the control vault in the pocket of the president of the company, this danger is minimized.

Experience in England indicates that ventilation is a problem in a blackout. Since controlled ventilation is a feature of this building, means had to be devised to insure that no tampering with air supply is likely to occur.

Blowers and heating and compressor units are all located in the underground concrete control room. Air is distributed by a duct system in the roof trusses. Return to the blower in the vault is through 5 x 4 ft. solid concrete tunnels placed underground around three sides of the building, within the building line. Water lines are placed in these tunnels for protection and for easy access.

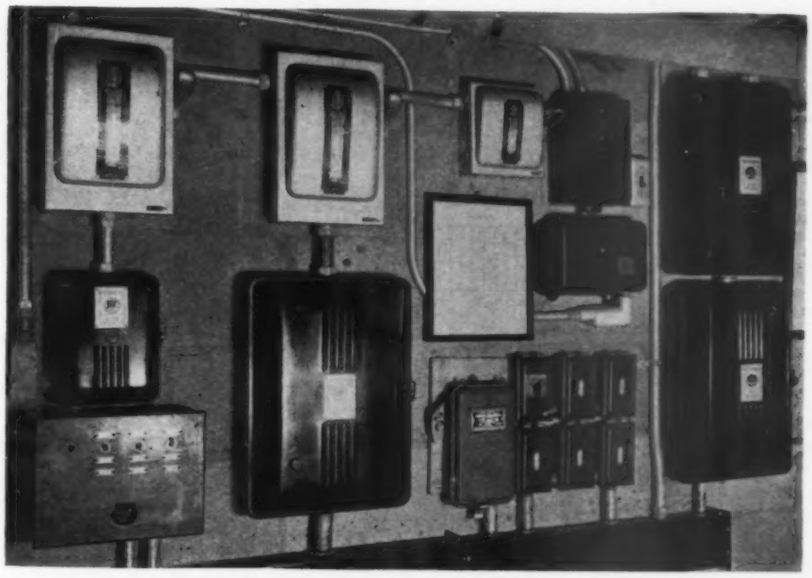
Both the heating and cooling systems are arranged in three zones—drafting room, shop, and office. The same blower furnishes warm air in winter and tempered air in summer. A thermostat for each of the three zones interlocks with the oil-fired boiler or the 50-ton ice machine. Desires of the workers in these three zones may therefore be satisfied and air velocities for each outlet can be adjusted by a fixed damper—in other words, the system can be balanced by these fixed dampers. But, again, blower, heater, ice machine, and their

controls are in the vault and inaccessible except to authorized persons.

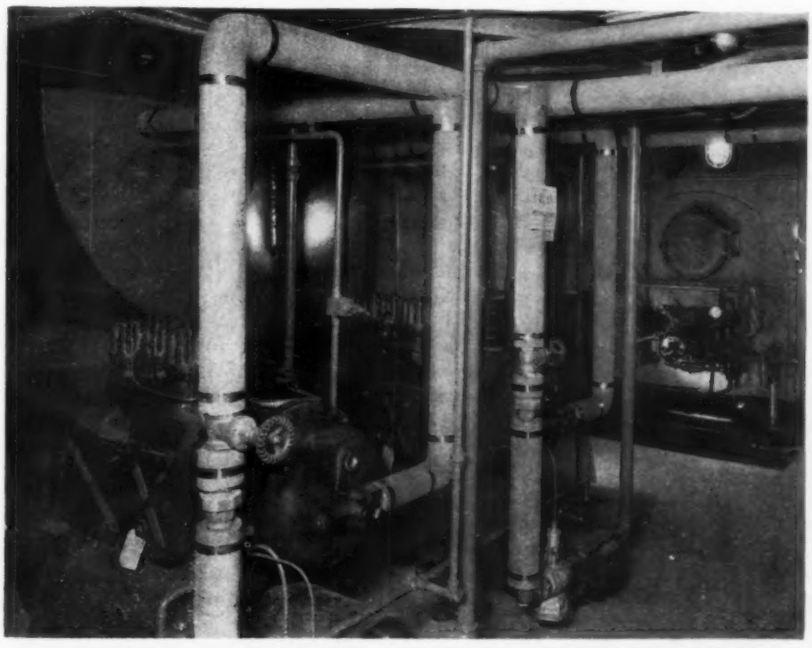
Exits present a problem in plant protection. Local ordinances regarding fire exits must be observed. Plans are being developed to control the three emergency exits electrically. They are located adjacent to supervisors' desks and therefore under control to that extent. Although there are three exits from the building, no one can leave the 5-acre yard without going by the watchman's gate. The woven-wire fence is surmounted by barbed wire.

Everyone must enter the building through the one lobby door. The receptionist, by electrical contacts, can control the part of the plant—shops, drafting room, or office—to which each person is admitted. In addition, no one whose workplace is in one part of the plant may go to any other part of the plant unless a supervisor unlocks the door. A draftsman, for example, cannot go into the shop unless his drafting-room supervisor and the shop supervisor unlock the door. Telephone communication with the outside is closely supervised to avoid that means of passing out information. Plant intercommunication is by radio amplifiers. All outside visitors are announced in that way—and all visitors, incidentally, are announced in the president's office as a measure of supervision and control.

The watchman's gate is a danger point. It could be a way of gaining unauthorized entrance to the plant grounds under the pretext of late deliveries, if the guard were not adequately protected. The guardhouse at the gate is within a few feet of an exit from the lobby, which, of course, is controlled by the receptionist. The guard, consequently, may enter or leave his house behind the protection of the barbed-wire-topped fence. Windows in the guardhouse are of safety glass. This one plant gate is never opened except for plant deliveries or receipts by trucks; employees use the lobby entrance. The building is floodlighted at night.



Controls for all utilities—heat, light, air—are all in a concrete vault below the building. The only key to the only door is kept in the president's pocket



Controlled ventilation made it necessary to be sure that air supply could not be tampered with. Blower and heating and compressor units are in the underground vault, inaccessible to all but authorized people

Protection for drawings, prints, and specifications had to be carefully planned. Every drawing, print, and specification is checked in at night and out in the morning from a central file. Overnight storage is in safes with combination locks. The combination is known by only one person. Instead of a central locker room, a locker without a lock is provided at each board in the large drafting room. The combination of locker room to toilet window to outside accomplice is thus not available in this plant.

As an additional precaution, the engineer's desk is located where he can observe everyone entering or leaving the drafting room. It must not be assumed, of course, that all employees are under suspicion. They are not, but we want to be in a position to detect any irregularities likely to be perpetrated by a saboteur gaining access as a visitor, or, in spite of rigid selection, as an employee.

We planned all this protection as a means of preventing work stoppage through the crippling of the essential services of power, light, and air. That is, we feel, of real importance when every man-hour is of significance to the national defense effort.

Flame Cleaning Helps Save the Surface

It's a comparatively new way of preparing steel and iron surfaces for painting, by burning off mill scale, rust, or old paint, providing thereby the clean, dry surface that makes for an effective paint-bond

J. G. MAGRATH, Applied Engineering Department, Air Reduction Sales Company, New York

PROTECTION of plant structures against deterioration is a maintenance problem requiring perpetual attention. Particularly is this true where the structure is of steel. If the surface is not provided with complete protection, corrosion will develop, resulting in impaired steel plate and structural shapes to a degree that requires partial repair or replacement, and sometimes rebuilding.

The major causes of corrosion are water, clean or polluted; ordinary atmospheric conditions; dampness due to lack of ventilation; moisture given off by coal and certain stores; moisture bearing cinders and rubbish; products producing moisture, acid fumes, and gases; brine, salt, and salt water sprays; metal impurities, or proximity of dissimilar parts (electrolysis); smoke; sewage, permeable paint.

Puts Heat to Work

Although the flame cleaning and dehydrating process is relatively new, having been in use less than three years, the rapidity with which it has been accepted and adopted as a means for surface conditioning structural steel and plate by the bridge and shipbuilding industries is sufficient proof of its satisfactory performance. Plant maintenance engineers are now showing an increasing interest in the possibilities of this process to solve some of their cleaning and surface reconditioning problems.

In addition to the employment of the flame for the removal of mill scale on new steel, and for paint burning and surface conditioning of erected and painted steel structures, the process has proved itself applicable for removing scale and sulphur from tire molds and vulcanizers, incrusted gypsum from aluminum molds, cement and concrete incrustation from contractors' equipment, heavy paint from concrete, heavy grease from concrete floors, in addition to enamel from sinks and tubs.

When used on new steel, the oxyacetylene process of flame cleaning and dehydrating consists of rapidly removing loose and semi-adherent mill scale and other surface impurities, as well as driving out occluded moisture, by heating deposits and surface with a multiflame oxyacetylene tip. The surface is rapidly heated to above 212 degrees Fahrenheit (but below 300 degrees Fahrenheit), all moisture, on the surface and within the scale and rust layers, is driven off, scale and rust bond are broken, and the surface is left warm. Scale and rust are immediately wire-brushed off, and primer painting follows while the steel is still warm (about 100 to 125 degrees Fahrenheit).

When a surface has deteriorated because of failure of the undercoat paint, it is more economical to clean down to the base, and recondition the steel before repainting.

When flame cleaning is employed, it consists of rapidly heating the old paint and causing it to cockle and become free from its bond, by quickly passing a multi-flame oxyacetylene tip over the surface. All moisture from within the paint layers and between the paint and the steel is driven out.

Generally the oil in the paint on older structures has dried out, and such paint cracks and cockles quite freely under the action of the flame. Where paint is reasonably new, possibly three or four years old, but must be removed because of failure from improper initial surface conditioning, difficulty may be encountered because even though the paint has lost its bond, it still retains much of its oil. Therefore it is tenacious and has a tendency to gum under the flame action. Consequently, several passes of the flame and wire brush may be required to clean the steel thoroughly. Sandblasting may be less expensive. But flame dehydration should follow, to remove all moisture. Tests have indicated that this process is effective on nearly all types of paint, except aluminum and other kinds of metallic pigment paints.

Flame Dehydrates Rust

Deposits of asphalt, tar, and heavy layers of old rust are removed with scrapers. Rust cannot be completely removed with any flame. The high temperature oxyacetylene flame dehydrates the rust, driving off all moisture—which is the bonding agent—and thus breaks down the structure preparing it for removal by a wire brush. Removing heavy rust layers, $\frac{1}{16}$ inch or heavier, with the flame is wasteful, because it can be more readily displaced with long-handled scrapers.

Nor should the flame be employed to burn off heavy paint accumulations. Quite frequently, where a misguided attempt has been made to keep maintenance painting costs at a minimum by repainting with layer after layer of paint, without properly reconditioning the base surface, paint layers of as much as $\frac{1}{8}$-in. thickness are encountered. This accumulation can be

removed economically only by chipping or scraping. Then the final layer of paint is removed with flame, complete dehydration being obtained at the same time.

Dehydration has been proved essential to the lasting qualities of paint. Need for an intimate and uninterrupted bond between steel and paint has long been recognized. If loose scale and rust remain on the surface with moisture present, and invariably it is present, and the surface is painted without thorough drying, the moisture and oxygen sealed within result in an imperfect paint-bond, oxidation continues at the interface, resulting in lifting the scale and breaking the paint seal.

Employment of the flame cleaning and dehydrating process involves no large outlay in new tools or equipment. Standard oxyacetylene welding or heating torches are available in almost every plant maintenance department. Standard extensions are available for such outfits to which are affixed the flame cleaning and dehydrating tips.

The flame application is immediately followed by wire-brushing. Where it will suffice, ordinary hand wire-brushing is satisfactory, but where the paint and paint scale deposit are heavy, power wire-brushing should be employed. Where several flame passes are necessary, intermittent hand wire-brushing may be done. Scrapers may be employed between and after flame passes, if found advisable. The final brushing should remove all loosened rust, scale, and cockled paint.

Paint should be applied to the surface promptly after wire-brushing, while the temperature of the steel is still above the atmospheric temperature, but not hot enough to separate the oils from the paint. Where a long interval must elapse between final brushing and painting, the surface should be reheated with the flames immediately before painting.

For Safety's Sake

It is recommended that operators of torches and wire-brushes wear goggles at all times. Respirators should be employed when necessary and, if operators are confined in a closed area, forced draft ventilation should be provided. The rules and safety practices that apply in handling oxyacetylene welding and cutting apparatus apply also to flame cleaning.

Because flame cleaning does not cause dust, no health hazard to personnel is present. Areas to be cleaned can be shielded, and plant production proceed without serious interruption.

Heated by oxyacetylene flame to loosen old paint and rust, and vigorously wire-brushed, surface is repainted while still warm enough to prevent condensation but not hot enough to separate oils from paint

This process should not, however, be considered a "cure-all." It is subject to limitations. It will not remove refrigeration brine deposit, asphalt or other bituminous paint, waterproofing compounds. It is not recommended for removing paint from lime plaster. Where steel is partly incased in or affixed to concrete of moisture bearing tendencies, it is useless to endeavor to obtain and retain a passive surface condition. Moisture-bearing and absorbing concrete cannot be dehydrated with the oxyacetylene flame; other means of waterproofing must be employed. At no time should the flame be used on tanks, vessels, containers, or piping that have been or are being employed as holders or carriers of gases, oils, or other inflammable or explosive materials.

Many variables, of course, enter into the cost of reconditioning a plant structure prior to maintenance repainting—size, accessibility, number of old paint coats, degree of corrosion, and quality of reconditioning job required. In many instances, flame cleaning may be preferable to other methods. It is, however, costlier than ordinary wire-brushing, a process which is not always completely satisfactory.

As a basis for estimating a rough figure of 4 to 6 cents per square foot can be used, allowing $1 per hour for labor. Labor represents about one half this cost. This figure includes oxygen and acetylene, labor for flame and brush application, and fuel for a portable compressor for operation of power wire brushes. These costs do not include cost of apparatus, brushes, scrapers, staging, compensation insurance, or overhead.

Speed of Operation

The flame application, employing a 6-in. flat tip proceeds at an average rate of 4 square feet per minute. (A 12-in. tip about 8 square feet per minute.) A round tip will burn about 2 square feet per minute. The extent to which one or the other is employed will vary according to the nature of the work. Hand wire-brushing and scraping should be figured on the basis of 1 square foot per minute.

If any of the available methods other than the oxyacetylene flame are employed for heavy paint and rust scale removal, the flame may follow such operation for the final surface conditioning and dehydration. The same procedure and technique are used, except that the speed is nearly doubled, and the cost therefore reduced by half. The absence of heavy paint and scale permits the surface to be heated more quickly than if covered with rust, and the job reaches completion in short order.

How to Add Years to Centrifugal Pump Life

Pick them right, install them right, treat them right—then, and only then, can they be expected to operate at highest efficiency for long periods of time

M. L. MURDOCK, Assistant Engineer, Hydraulic Department, Allis-Chalmers Manufacturing Company, Milwaukee

A CENTRIFUGAL PUMP is a simple piece of machinery, but it requires a certain amount of attention while in operation as well as care in installation. The operating life of a centrifugal pumping unit, working at its highest possible efficiency and at low maintenance cost, is directly proportioned to the thought, time, and care given to it.

Before any pump is installed it is the operator's task to determine the characteristics of the liquid that is to be handled and decide, or find out, what metals should be used in the construction of the unit. He may feel free to ask any pump manufacturer for recommendations. If he wishes, he may send a sample of the liquid for analysis, on which can be based recommendations as to the most suitable metals to be employed in constructing the pump.

In too many instances the purchaser does not mention that an acid, alkaline, or corrosive liquid is to be handled. It is unreasonable, however, to expect a pump designed to handle clear water to stand up under such unfavorable operating conditions.

In power plant installations it is not uncommon for the specifications to state that the pH value of the water being handled is approximately 7.00, and then find excessive wear on the internal parts after the pump has been in operation for some time. Such wear can usually be traced to either a high or low pH value, quite different from a value of 7.00. The pH value refers to the concentration of hydrogen ions in a liquid and indicates whether it is weakly or strongly acid, or neutral, as Figure 1 shows.

Figure 2 shows the metals recommended for pumps handling liquids of various pH values.

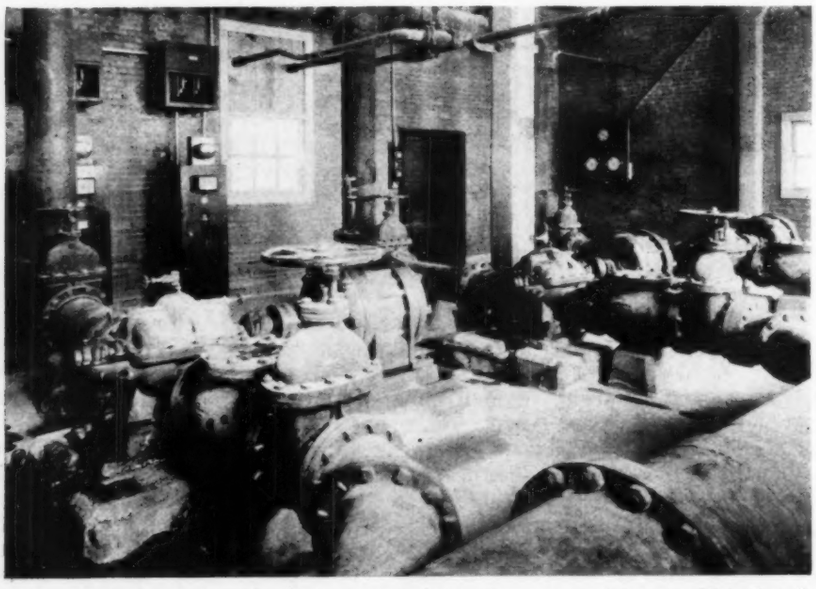
Determination of the pH value of water thus serves as a tentative guide in the selection of suitable materials for pumps if other factors concerning treatment of the water are also given proper consideration. It is important to consider not only the pH value of the water, but also the kind of softeners used, the method of softening, and the contents of the boiler feed water.

It is necessary to know the analysis of the water in order to be sure that any constituents of the liquid will not affect the metals used in the pump, or will not cause electrolytic action between two dissimilar metals, when in contact with a strong electrolyte.

The following information should be submitted to the manufacturer in connection with any boiler feed pump inquiry:

1. Temperature of the water at the pump.
2. The pH value of the water.
3. Dissolved oxygen content.
4. Ammonia concentration.
5. Sodium chloride concentration.
6. Sodium sulphate concentration.
7. Hardness and alkalinity.
8. Percent of make-up.
9. Type of treatment water will receive.

With this information, the manufacturer will be able to select a pump



Three centrifugal pumps, each rated 2,500 gallons per minute at 95-ft. head, 1,750 revolutions per minute, furnish water to a large food products plant

and materials that will give the maximum operating life and efficiency at minimum cost.

It can safely be estimated that 75 percent of centrifugal pump troubles originate on the suction side of the unit. This type of pump is extremely sensitive to even a small amount of air, and if an excessive amount of air enters the runner inlet, loss of prime results. It may even cause the pump to run dry.

The first rule when installing suction piping is to make absolutely certain that there are no leaks in the piping to allow the infiltration of air into the suction line, and thus into the centrifugal pump.

Constant, Gradual Slope

The second rule is to make certain that the suction piping has a constant, gradual slope upward from the water source to the pump suction nozzle. It is important to have this gradual slope in order to prevent the accumulation of any air in pockets, which would materially affect the operation of the unit. If the suction piping is larger than the suction nozzle of the pump, an eccentric reducer must be installed so as to prevent any further possibility of air pockets.

Another important matter in connection with suction piping, which also applies to the discharge piping, is that there must not be any transmission of stress from the piping to the pump flanges. The suction and discharge piping must be installed in such manner that it may be bolted to the pump flanges without producing any stresses or strains, either when the pump is being installed or during any period of operation.

Characteristics of a typical centrifugal pump are shown in Figure 3. The curves give the variation of head, efficiency, and brake horsepower with capacity, together with the maximum capacities for various total dynamic suction lifts.

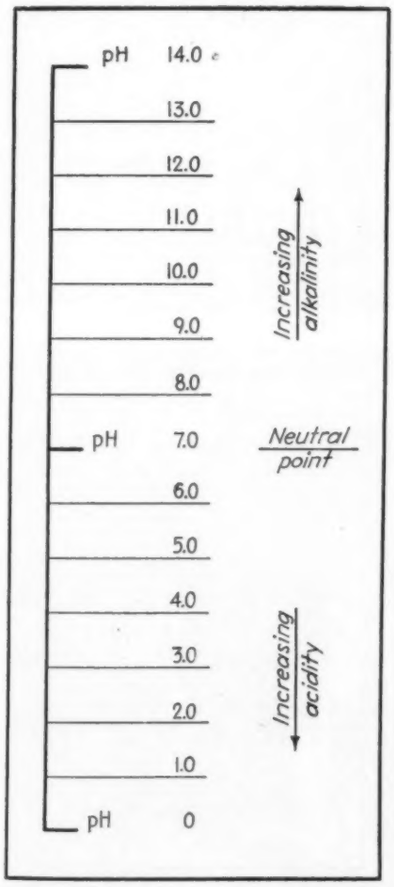


Figure 1. The degree of acidity or alkalinity of a liquid can be expressed through the pH value

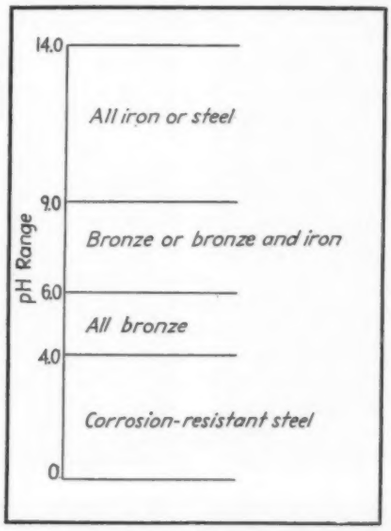


Figure 2. The pH value of the liquid to be handled by a pump is important in determining the materials from which it should be made

The head curves show that, if the pump operates at a higher pressure than that for which it was bought, the capacity will drop off accordingly. Conversely, should the discharge pressure be lower, a greater amount of water will flow and the brake horsepower will be correspondingly higher.

The speed of a centrifugal pump naturally affects the characteristic curves since they invariably follow these relationships:

$$G.P.M._1 \div G.P.M._2 = Speed_1 \div Speed_2$$
$$Head_1 \div Head_2 = (Speed_1 \div Speed_2)^2$$

These relationships are illustrated by the following points in Figure 3:

At 1,750 r.p.m. Head = 225 feet; Capacity = 2,500 g.p.m.

At 1,150 r.p.m. Head = 97 feet; Capacity = 1,640 g.p.m.

Therefore, if the speed of the unit drops below the rated value, both the head, or pressure, and capacity will obviously decrease in accordance with these relationships.

When the suction lift is high, say 20 feet, and the discharge pressure is lower than anticipated, the pump operates along the 20-ft. suction lift line under unsatisfactory and unstable conditions (known as "break off" conditions), which have a tendency to reduce the efficiency and operating life of the unit.

The unit usually is shipped with the pump and driver mounted on a common baseplate, with the coupling pins removed, and the motor left undoweled to the base. This procedure is followed so as to allow the pump to be grouted in and secured rigidly before final alignment of the pump and driver. The driving unit should then be doweled to prevent any shifting of position during operation, and in addition make it easier to realign the pump and driver after inspection or dismantling of the unit.

Coupling Must Be Aligned

Most units are supplied with a flexible coupling between the pump and driver. It is necessary to realize that a flexible coupling will not operate under any misalignment greater than approximately 0.002 inches. Greater misalignment may cause overheating of the bearings or vibration. Both conditions are detrimental to the operating efficiency of the pump and therefore should always be closely guarded against.

The stuffing box (or boxes) where the shaft passes out of the pump is an annular chamber between the shaft sleeves and a machined surface into which packing of the same size as this annular clearance is placed.

On a high-speed shaft it is the function of this packing to throttle, not to eliminate, leakage. This statement may seem surprising, but when viewed from the standpoint that packing requires lubrication in exactly the same manner as a bearing, it does not appear so controversial. Packing materials are so pliable that by excessive tightening of the gland bolts all liquid can be ex-

cluded from the stuffing box, thus producing close contact between the packing and sleeve and causing destruction of either or both.

Each ring should be placed in the box separately and tamped in until it is seated in the box firmly and securely before the next ring is put in.

The gland, which is usually split and made an easy sliding fit on the shaft, is then placed around the shaft to hold the packing securely in the stuffing box. Remember that the gland does not require excessive pressure to hold this packing in place and cause it to form an effective seal. The glands should be loose enough to allow a small amount of leakage to flow from the stuffing box. This leakage will assure the packing of adequate lubrication to prevent it from becoming overheated and scoring the shaft.

Adherence to these simple rules and principles, plus observance of all instructions put out by the manufacturer of the pumping unit, will assure long, efficient operation, at minimum expense for maintenance.

In installations where it is necessary to have an automatic priming arrangement, it is important that the priming connections on the pump be made in the proper manner. Figure 4 shows part of the cross-section of a double-suction pump. It will be noted that there is one hole in the top of the casing, and two others directly above the inlet to the runner, one on each side of the casing.

Under ordinary operating conditions, where the pump operates under a suction lift and is primed before the motor is started, the tapped hole in the top of the casing is used for priming. Where automatic priming is employed, however, it is necessary to prime the pump from the two tapped holes that are placed directly above the runner inlet.

Draws All the Air Out

It has been found that, if the automatic primer is connected into the top of the casing only, the centrifugal action of the rotating impeller will fill the priming line completely with water and thus prevent the priming equipment from drawing all the air out of the pump casing. On the other hand, if the priming connections are made in the holes over the inlet to the runner, the priming equipment will draw all the air out of the pump and continue to function after the pump has been put into operation, thus eliminating danger of its becoming airbound.

Centrifugal pumps may lose their prime in several ways, but is has been found that in most cases it is due to the following causes:

1. **Improper priming before starting the pumping unit.** It is extremely important that the pump be properly primed, and the casing devoid of air before placing the unit in operation.

2. **Suction line is not airtight.** As mentioned previously it is necessary that the suction line be absolutely airtight so as to prevent any infiltration of air into line, and thus into the runner inlet. A very small amount of air in a centrifugal pump will cause it to lose its prime; consequently, special care must be taken to prevent the entrance of air into the suction line, or the runner inlet.

It is also important to avoid any possibility of loops or air traps in the suction piping. The piping should have a gradual slope from the water source, regardless of whether a positive or negative suction is involved.

3. **Improper installation of valves.** Trouble on many installations occurs when valves are installed in the suction line with the bonnets standing upright. This position permits the accumulation of air in the bonnet and may prove troublesome in instances where the pump operates under a high suction lift.

It is recommended that valves in the suction line be installed with their bonnets in the horizontal position. This can be done either by installing the valve in a vertical section of piping or by turning it on its side, in a horizontal run.

4. **Air pocket in suction-line check valve.** In one installation a check valve was placed in the suction line of a boiler feed pump. This valve was installed in a horizontal section of piping and permitted an air pocket to form in the top of the valve. This air pocket caused erratic operation of the pump until a vent line was placed in the top of the check valve. It permitted air to escape from the pocket, and thus prevented it from getting into the pump.

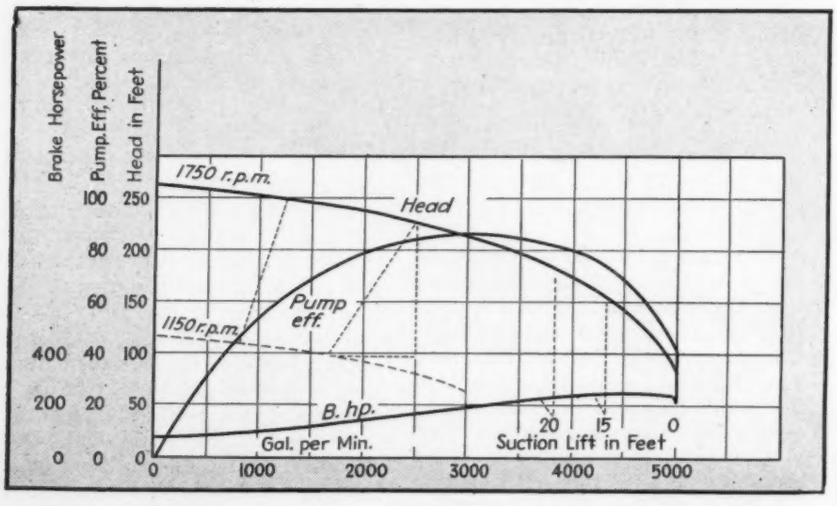


Figure 3. Characteristic curves for a single-stage, double-suction centrifugal pump give the variation of head, efficiency, and brake horsepower with capacity, and maximum capacities for various total dynamic suction lifts

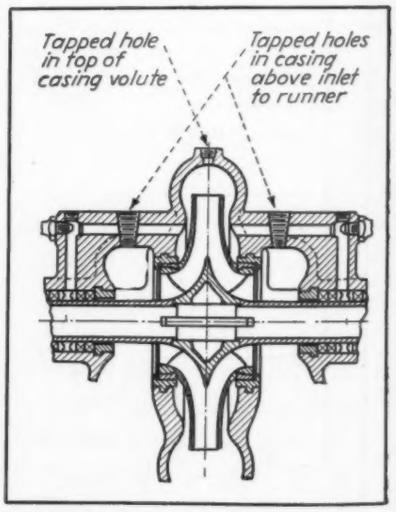
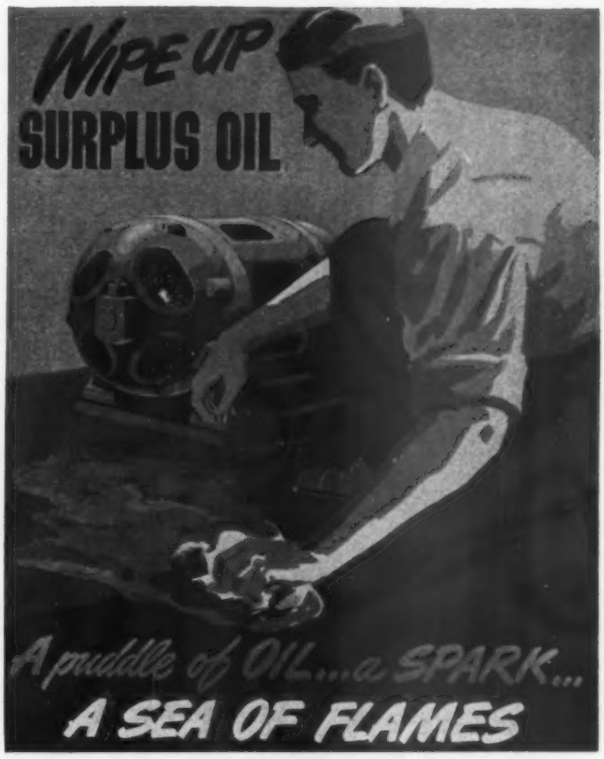


Figure 4. When automatic priming is provided for a pump, use the two holes above the inlet to the runner

Don't Let That Fire Start

Bethlehem Steel Company uses colored posters to point out specific danger spots



Electric Immersion Heaters Lick Many a Job

Because they are versatile and easy to install. In this and a succeeding article are some facts that will help you to apply these heaters properly

H. M. CHATTO, Industrial Heating Specialist, General Electric Company, Boston

A native of South Brooksville, Me., H. M. Chatto was graduated from Bowdoin College in 1915, with a B.A. degree, followed by a B.S. degree from Massachusetts Institute of Technology, in 1923. He then joined the General Electric Company in Schenectady. In 1926 he was appointed industrial heating specialist for G.E.'s New England district. Mr. Chatto lives in Cambridge, Mass., likes music, his home workshop, and boating.

How to Heat low-temperature tanks, kettles, and other equipment, often presents a problem that is most easily solved by the use of electric immersion heaters. Most of these applications require the production of hot water or steam.

Oil-immersion heaters, which are in many ways similar to the other type, are also widely used. In order to get the best service from these types of heaters it is necessary that certain facts and principles be kept in mind when selecting and applying them.

Water-immersion heaters are available in two types. One has a threaded head, which makes for easy and relatively permanent application to tanks and vessels. The other type hangs over the side of the tank or container that is to be heated, and is readily portable.

Heaters having the threaded head are available in many standard sizes and ratings. For heating water a copper-sheathed heater, fitted with a brass header threaded in standard pipe sizes for easy installation, is used.

Typical formations for heaters of the type adapted for hanging over the side of a container are shown in Figure 1. These heaters have relatively long, cold terminals. This construction limits the generation of heat to the lower portion, which is well under water when in use. The heaters shown are designed particularly for use in tanks of wood, concrete, slate, or other materials that are not readily adapted for heaters with threaded heads. Since they are removable, they can be changed from one container to another if desirable.

Three Heats Possible

Considering a few typical applications, construction of an insulated tank fitted with a water-immersion heater that is connected by standard wiring to a snap switch is shown in Figure 2. A single heat is often all that is needed; if wanted, three heats can be provided. To provide this variation two heaters of the same rating are connected to a three-heat switch. On the high-heat position both resistors are connected in parallel; on the medium or half-heat position one resistor only is connected. The low or quarter-heat position has both resistors connected in series.

For convenience and compactness, two resistors are frequently assembled

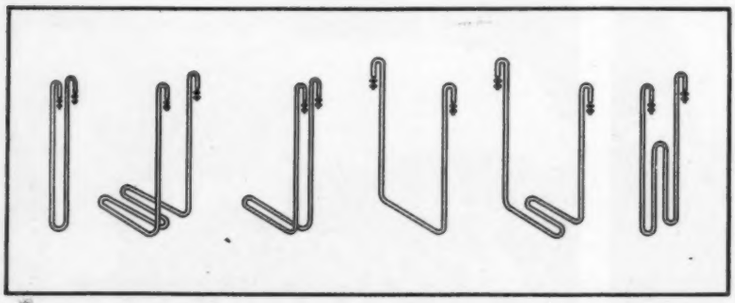


Figure 1. Immersion heaters of the over-the-side type can be bent into almost any desired shape

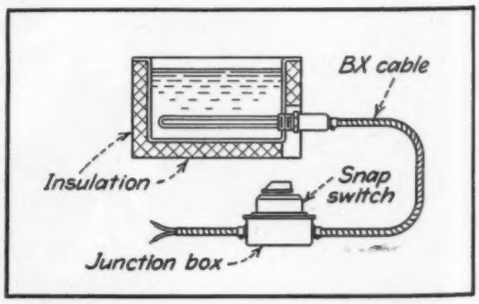


Figure 2. Insulated tank with immersion heater controlled by a snap switch

in one head and for that reason are often called three-heat units.

Snap switches are used only where it is not necessary to maintain close temperature control.

For temperature control and automatic operation a thermostat is used that, up to the carrying capacity of the contacts, does not require a relay or magnetic switch. Some thermostats have a rating of 25 amperes on alternating current, thus requiring no magnetic switches up to 2,875 watts on 115 volts, and 5,750 watts on 230 volts.

Automatic temperature control, as applied to large tanks where heavier connected loads require a magnetic switch, is shown in Figure 3. Although only one heater, connected single phase, is shown, several heaters may be used and balanced appropriately on two or three phases by the use of magnetic switches suited for heavy heating requirements. Figure 5 shows the wiring diagram for six heaters connected on three phases.

There are many applications where immersion heaters cannot be used directly because heavy, viscous materials such as asphalt, pitch, and heavy oils are involved. Such materials can best be heated by the use of a liquid jacket containing immersion heaters, as shown in Figure 4. The control is arranged to limit the temperature of the liquid in the outer jacket so that it will not be overheated. This arrangement also prevents unnecessary boiling out of the solvents present in many heavy compounds such as asphalt.

When water is used in an open jacket the temperature must, of course, be kept under the boiling point of water. For higher temperatures oil can be used in the jacket, up to the flash point of the oil, which may be as high as 600 degrees Fahrenheit.

Another class of applications requires the generation of steam under pressure. Steam jackets for kettles and molding presses are examples.

A typical steam-jacketed kettle having a side-arm heater made of ordinary pipe fittings and standard immersion heaters is shown in Figure 6. Convection currents keep the water in constant circulation. A water jacket reduces the transfer of heat to only a moderate rate. When quick transfer is desired the jacket must be heated by steam. This can be done by dropping the water level below the jacket, so that the side-arm heater becomes a steam generator, with the steam entering the jacket through the upper pipe connection and the condensate returning through the lower connection, in the bottom of the kettle.

Thus standard immersion heaters and temperature control equipment can be combined with ordinary pipe fittings to supply hot water or steam to steam-jacketed tables, rubber-molding machines, sterilizers, and so on. In such applications a means for supplying filling water must be provided; also a sight glass to indicate water level, and a safety valve. Since standard pipe fittings are generally accepted by all boiler inspectors as a means of carrying steam under pressure, the safety requirements are met very practically.

For rough estimates of heating and

Drills are cleaned, preparatory to rustproofing, in these two tanks, each of which is provided with immersion heaters rated 5,000 watts

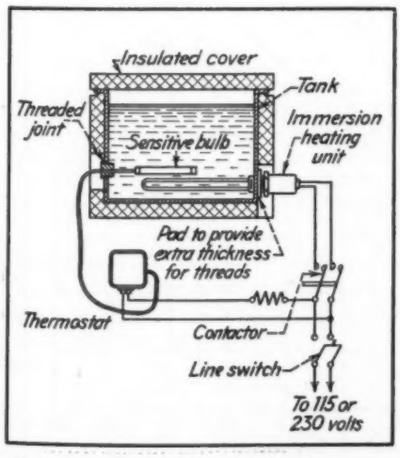


Figure 3. Automatic temperature control can be provided by adding a thermostat and contactor

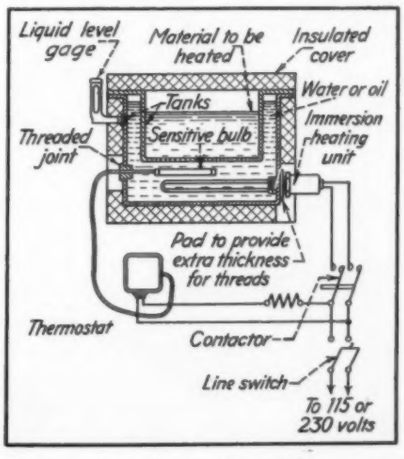


Figure 4. A double-walled tank heated by water or oil is used for materials that can easily be scorched

power requirements, remember that 1 kilowatt-hour is the equivalent of approximately 3 pounds of steam at atmospheric pressure, and that 1 ton of soft coal is approximately equivalent to 5,000 kilowatt-hours, assuming average quality coal and good efficiency of combustion.

Reference to steam tables will show the temperatures corresponding to different pressures, and how many British thermal units can be taken out of a pound of steam when it condenses in a steam-jacket—in other words, the heat that can be recovered.

Salt water or sodium chloride solutions quickly incrust ordinary water-immersion heaters because of their relatively high watts density—about 40 watts per square inch of external surface. This condition can be avoided by using immersion heaters designed for non-circulating oils, and rated only about one-half as high in watts density. Also, the steel sheath of the oil-immersion heaters will last longer than copper, although slight rusting will occur.

There are many water solutions of cleaning compounds, dyes, and other industrial chemicals that must be used hot. The chemical composition of these materials is known usually only by the makers. In many instances these solutions can be successfully heated by immersion heaters, but to apply them safely it is necessary to know what the effects will be on the sheath material. Sheaths of the heaters usually are made of well-known metals, such as copper or steel; if the user has not had direct experience with the chemicals in question, the maker should be able to supply information as to possible corrosion.

Standard heaters for certain special applications are on the market. These applications include low-temperature tempering salts, alkaline baths (such as sodium carbonate or sodium cyanide for cleaning solutions), sulphuric acid solutions up to 10 percent concentration, and plating baths.

Some applications involving the heating of chemicals can be taken care of by forcing hot oil through glass or lead tubing, which can be brought into contact with the chemicals without damage.

Electric heaters have been used for years to heat oil in both open tanks and closed pressure vessels. Any of the types of heaters discussed can be used in most instances, except that modifications to suit the use of oil must be made.

Oil absorbs heat more slowly than water. Therefore oil-immersion heaters have approximately double the heating surface of water-immersion units, or about 20 watts per square inch of heating surface. This conservative rating is necessary to avoid carbonizing the oil; also to prevent a heavy incrustation of carbon on the sheath. The sheath material of these heaters usually is steel, which withstands better than most other metals the higher temperatures incident to the use of oil, as well as the action of any sulphur compounds present.

With the double-boiler arrangement shown in Figure 4 it is possible to reach temperatures around 500 to 600 degrees Fahrenheit without resorting to pressure in the jacket, provided the jacket is filled with oil and oil-immersion heaters are used. Hot oil provides a practical method of heating a jacketed kettle or other device beyond the temperature corresponding to a safe steam pressure. An expansion tank can be used to keep the jackets full of oil in the same manner that expansion tanks are used on domestic hot water systems. At times the oil may need the help of a circulating pump to provide sufficiently swift heat transfer.

(The second installment of Mr. Chatto's article will appear in an early issue.)

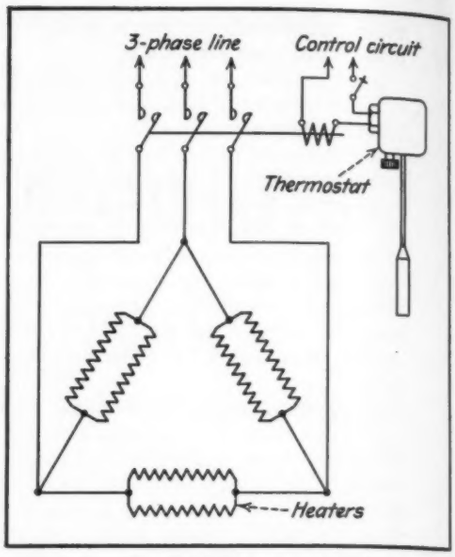


Figure 5. It's advisable to balance heaters on all phases. Here six are balanced on a three-phase circuit

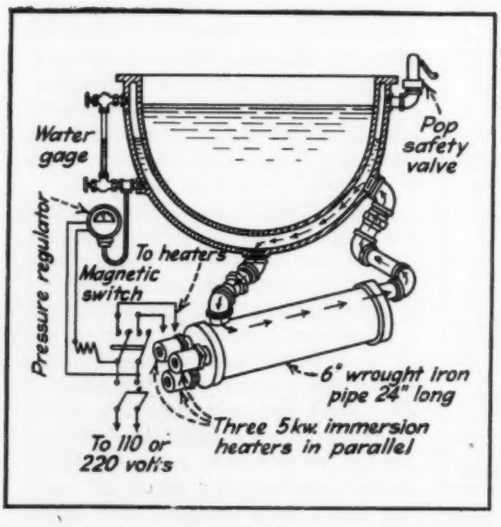


Figure 6. Arrangement when immersion heaters are applied to steam-jacketed kettles

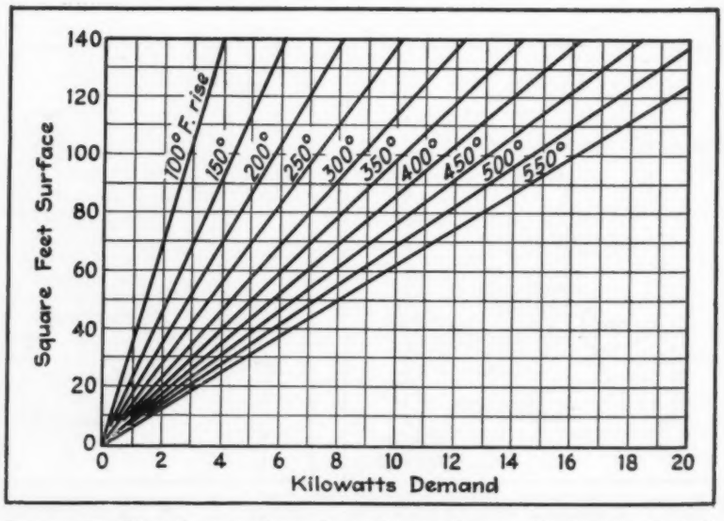


Figure 7. Heat losses through tank or other walls having 1 inch of good insulation can be determined from these curves

"Hanging" the Roof Saves Floor Space

Dry-room roof is held from above, instead of supported from below by columns

A LARGE DRY-ROOM, for drying and storing rayon used in the manufacture of automobile tires, with an entirely clear floor area unbroken by supporting columns, has been built of prefabricated light steel in the Los Angeles plant of the Firestone Tire & Rubber Company.

The room is built in the form of a rectangle, 70 feet long, 30 feet wide, and 10 feet high. It is constructed of sheet metal panels, held in tension between framing members, without any crossbraces, gussets, or struts. Its light, rigid structure, made it possible to suspend the roof by tie rods attached to overhead beams, and to eliminate entirely the use of supporting columns.

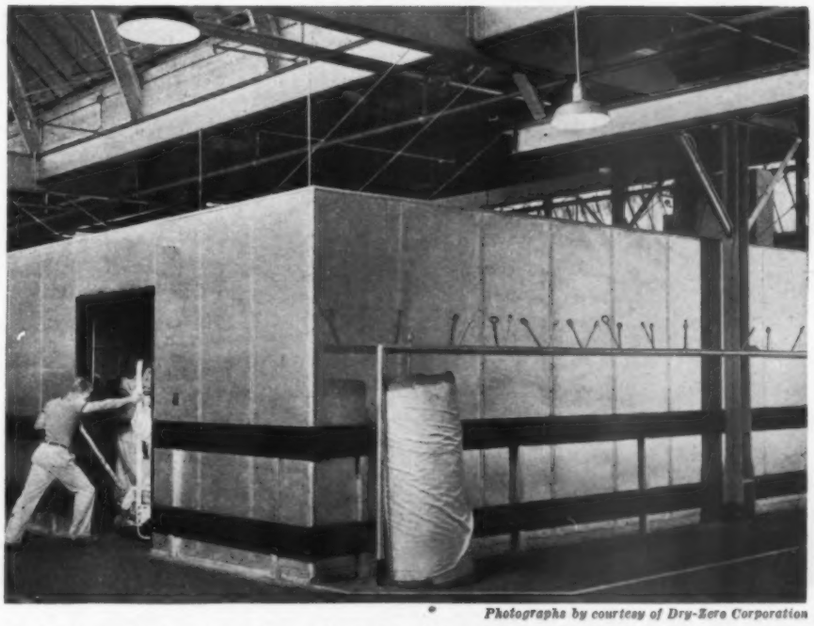
Light in Weight, but Airtight

It is almost completely airtight, and required only about five days to erect. The total weight, not including insulation or doors, is only 11,189 pounds, or approximately 5.3 pounds per square foot of floor area. The walls and ceiling of the interior are lined completely with one-half inch of rigid type insulation.

The temperature of the dry-room is held at 90 degrees with a maximum variation of only one degree. Relative humidity is maintained at 30 percent or less by cooling coils that extract the moisture from the air before it is reheated. The entire system delivers 4,000 cubic feet of air per minute through the cooling and heating coils and is efficiently powered by a 5-hp. compressor.

An interesting feature of the dry-room is the pushbuttom control of its doors to keep heat losses at a minimum. The doors at each end of the room are opened and closed by the drivers of the trucks that carry the rayon in and out. Consequently, the doors are kept open only when absolutely necessary to allow the passage of the trucks.

No columns here to obstruct free movement of materials. Temperature is controlled to within one degree, relative humidity maintained at 30 percent



Photographs by courtesy of Dry-Zero Corporation

Prefabricated sheet steel panels, held in tension between framing members make dry-room for rayon. Roof is suspended from beams by tie rods

MAINTENANCE SHORTS

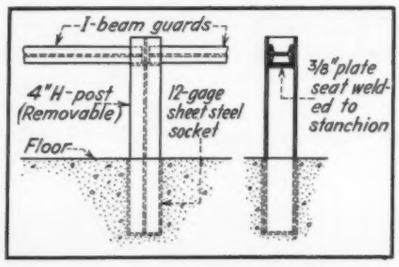
Readers are invited to contribute brief articles, illustrated when possible, reporting out-of-the-ordinary maintenance accomplishments. Accepted articles will be paid for

End Truck Damage With Strong Guards

THERON W. BEAN, Vallejo, Calif.

After experimenting with various types of ware guards, we installed guards consisting of pipe stanchions and hinged 4x4x¼-in. angle irons, forming a fence along all aisles in the factory warehouse where glass bottles and tumblers were stored in cartons ready for shipment. However, the pallet lifters and trucks occasionally collided with these angle-iron fences, twisting the hinges, bending the angles, and damaging the outer cartons of ware. Repeated efforts to get the truck drivers to use greater care in maneuvering helped to reduce the damage during normal periods, but collisions continued to occur with frequency when large rush orders required moving a great deal of ware from storage to the freight cars in a short time.

When a new 160,000-sq.ft. warehouse addition was constructed I designed a new type of ware guard which proved to be



stronger and lighter, and consequently easier to handle, than any type previously tried. The strength is obtained by setting the guard rail, a 3-in., 5.7-lb. I-beam, so that its greatest strength is in the horizontal plane. In this way it can best resist deformation when struck by a pallet lifter or truck. With the flange of the I-beam facing the aisle, this 3-in. I-beam offers considerably more resistance to bending than a 4x4x¼-in. angle of the same length. When an aisle is to be entered by the pallet lifter the I-beam is easily lifted out and laid on the floor, or turned over 90 degrees and slid into the space between the flanges of the I-beam of the adjacent section.

In the new addition the absence of damage to ware has demonstrated the protective value of these guards. They have greatly reduced the total amount of damage throughout the factory, as the new addition forms a large portion of the total warehouse space. Plans are under consideration for revamping the stanchions in the old warehouse section so that I-beams can be used for horizontal members, as illustrated.

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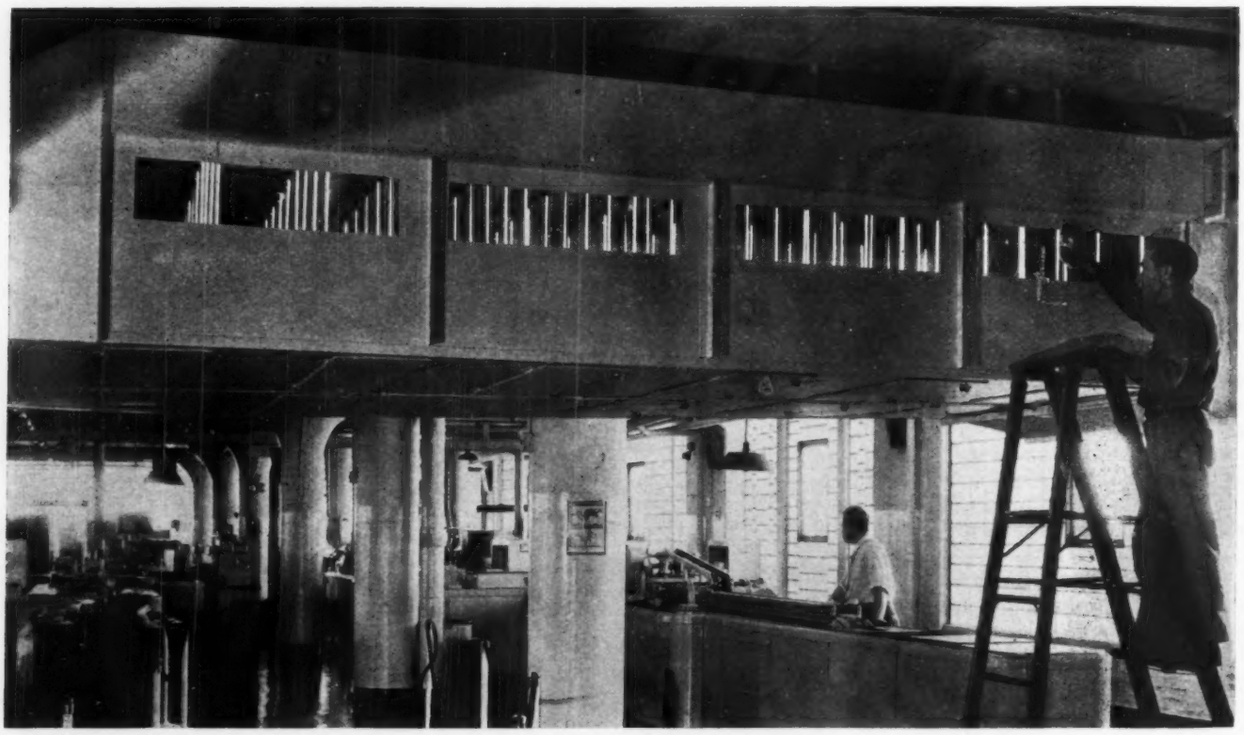
Find Eyebolts Without Hunting for Them

G. M. DAVIDSON, Production Engineer, Harley Davidson Motor Company, Milwaukee

Good-sized eyebolts used in lifting heavy dies, jigs, and fixtures used to be a nuis-



Bacteria free air is assured at Bristol-Myers Company's new plant at Hillside, N. J., by 104 Westinghouse Sterilamps. Air passing through the ducts at 40,000 cubic feet per minute is rendered 95 percent free of air-borne bacteria by rows of 30-in., vertically mounted lamps, placed 15 inches apart, in a special chamber. Twenty-six transformers are required for the 104 lamps

MAINTENANCE

can make you or break you in today's "Battle of Production"

EFFICIENTLY handling materials, freight and cargo, thousands of electric industrial trucks are now on the job 24 hours a day . . . powered with Exide storage batteries.

To keep these power trucks rolling, without interruptions, tie-ups or delays, is vital to our big defense job . . . the "Battle of Production."

So maintenance men welcome the Exide System for keeping storage batteries on the job with a minimum of attention.

This Exide System assures

- ★ **more efficient battery operation.**
- ★ **easier maintenance . . . with charging done automatically.**
- ★ **prolonged battery life . . . usually months more than the guarantee.**

Write *today* for the *free* booklet, "The Exide System for Better Material Handling."

Exide
IRONCLAD
BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia
The World's Largest Manufacturers of Storage Batteries for Every Purpose
Exide Batteries of Canada, Limited, Toronto

There's no need to hunt around for eyebolts; each size is always stored on its own peg

ance to take care of. There are only a few of each size and the eye makes them difficult to stack neatly. Hence it usually took a good deal of time to find the right one.

Our toolroom storekeeper eventually worked out a way to handle these eyebolts so that they take up little space, are always in sight, and can be handed out as easily as so many standard drills. As shown in the illustration, he set a number of wooden pegs and bolts of the proper diameter for the different sizes of eyebolts into a heavy board.

Now each pair, or half-dozen, eyebolts of any given size hangs neatly from its own peg, ready for use.

•

When Unit Heaters Are Inspected

S. H. COLEMAN, Roanoke, Va.

Unit heaters require little maintenance attention. Periodic check-ups are necessary, however, to insure operation at maximum efficiency.

Such inspections are best made after the heating season has ended. Points to be checked are as follows:

1. *Motor.* Check lubricating devices bearing wear, internal and external cleanliness, airgap clearances, wear of brushes and commutator or slip rings, condition of centrifugal switch, tightness of frame and base bolting, alignment and mechanical condition of shaft couplings, voltage at motor terminals.

2. *Starters.* Check contacts, condition and setting of overload devices, functioning and mechanical condition of thermostats.

3. *Fan.* Examine for cleanliness of blades, balance, evenness of blade spacing around hub, tightness of joint with shaft, bearing wear, lubricating devices.

4. *Heating unit.* Check for leakage in steam passages and connecting piping; presence of dirt and lint in air passages; tightness of frame, casing, and supports; louver and damper settings; vibration characteristics of unit.

5. *Steam inlet valves.* Inspect for ease of operation; condition of packing, gaskets, and seating surfaces; operation, setting, and condition of diaphragm, thermal control elements, sylphon bellows, and all other parts.

6. *Condensate drainage trap.* Examine for cleanliness of strainers, drip legs, and trap interior; condition of valve seating surfaces; wear of internal parts; condition of bypass and shut-off valves; functioning of thermostatic elements; adequacy of return piping.

Fishpole Aids in Ceiling Measurements

A. W. EIDMAN, Cleveland Heights, Ohio

Few jobs are perhaps more exasperating than those of the plant engineer who must plot the location of interferences on high ceilings for the running of conveyors and pipelines.

When approximations won't do, and transit work is impractical, the common fishpole will usually turn the trick.

A stiff, jointed fishpole is assembled on the job and a plumb bob fastened to the end of the line. The pole is raised till the tip reaches the point to be measured and the line allowed to slack away through the fingers till the plumb bob touches the floor. A chalk mark fixes this point. Successively all points may be thus transferred to the floor, where they can be accurately measured.

A rubber point cemented to the tip of the pole is helpful in keeping the rod from moving. Approximate elevations can be determined at the same time by measuring the length of line paid out from the tip of the pole to the plumb bob as it first clears the floor.

•

This Clutch Operated Its Motor to Destruction

H. E. STAFFORD, Port Arthur, Ont., Canada

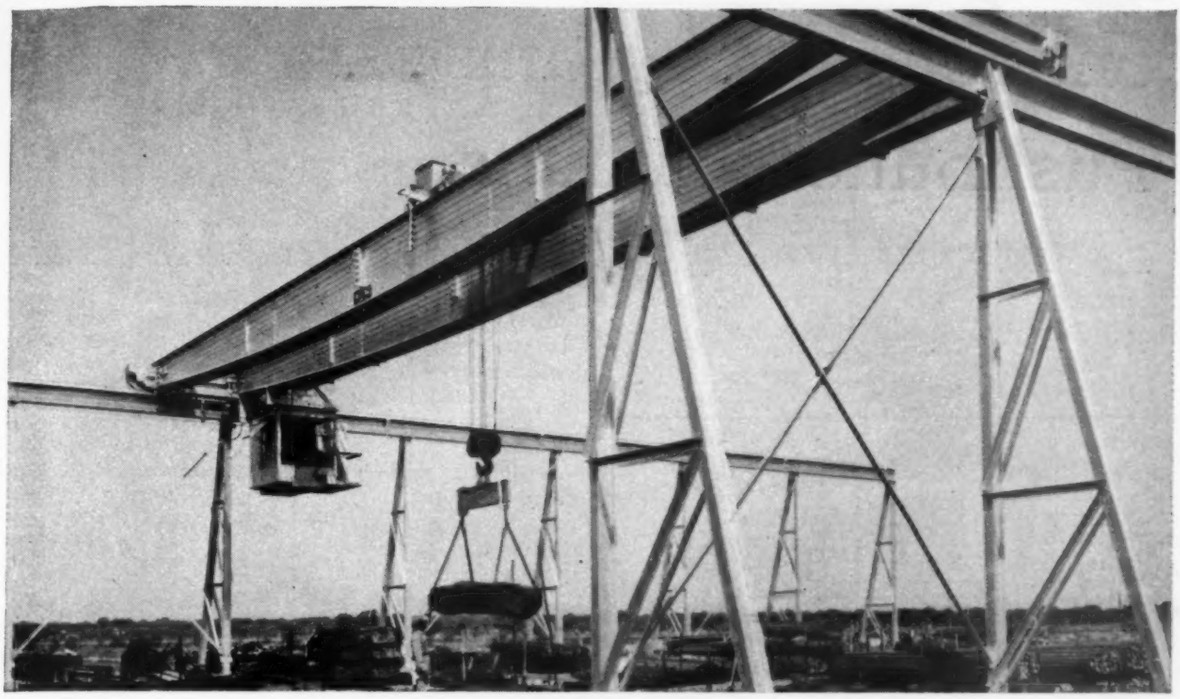
The importance of making sure that mechanical drives on machines are correctly assembled, particularly when more than one motor is involved, was dramatically demonstrated by a mishap that took place when a rubber calender was started up after installation.

This machine was equipped with three motors: one of 75-hp. rating for high and medium speed operation; a 10-hp. motor for inching; and a 3-hp. motor for raising and lowering the rolls. The 75- and 10-hp. motors were connected to the bottom roll through a train of gears, the 10-hp. motor also being equipped with an over-running clutch. Ratio of the gear drive for the 75-hp. motor was 3:1, while a ratio of 60:1 was used for the 10-hp. motor.

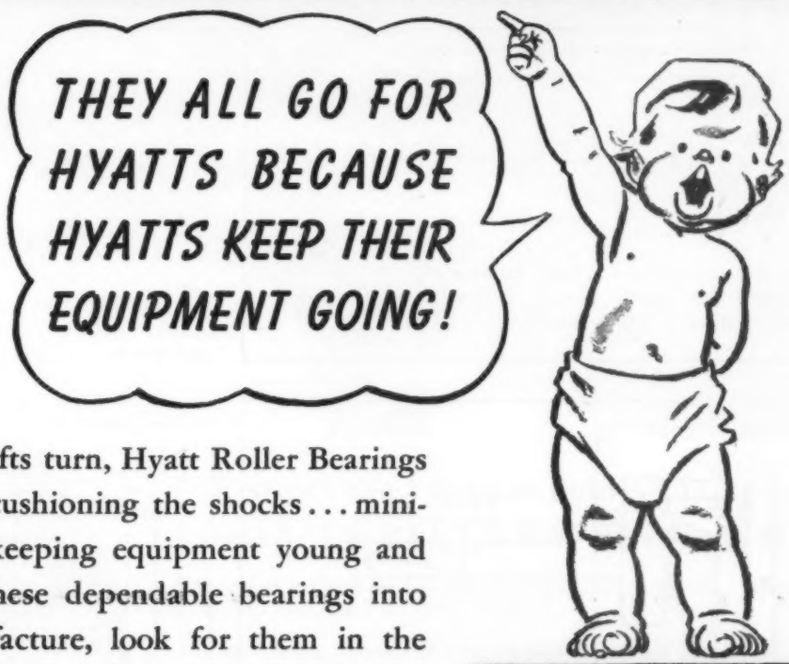
Maximum speed of the bottom roll was 1,100 feet per minute, while the inching speed was 78.5 feet per minute.

In connecting the over-running clutch the mechanic assembled it backwards, so that when the 75-hp. motor was started it drove both the bottom calender roll and the 10-hp. motor. On the basis of the gear ratios the smaller motor could have reached a speed of $(855 \div 3) \times (60 \div 1) = 17{,}100$ revolutions per minute. It did not, however, hold together long enough to reach this speed. Before the larger motor reached a speed of 200 revolutions per minute, the 10-hp. machine practically exploded.

KEEP THEM YOUNG WITH HYATTS



Cranes for yard or indoor service, built by WHITING CORPORATION, are Hyatt equipped to assure freedom from bearing wear and care.



Wherever wheels and shafts turn, Hyatt Roller Bearings are carrying the load . . . cushioning the shocks . . . minimizing friction . . . and keeping equipment young and ever on the go. Build these dependable bearings into the machines you manufacture, look for them in the equipment you buy, and let us give you any further data desired. Hyatt Bearings Division, General Motors Sales Corporation, Harrison, New Jersey; Chicago, Pittsburgh, Detroit and San Francisco.

HYATT

ROLLER BEARINGS

QUIET

Connection Diagrams for Pushbutton Circuits

E. B. ANKENMAN, Engineering Division, Westinghouse Electric & Manufacturing Co., Boston

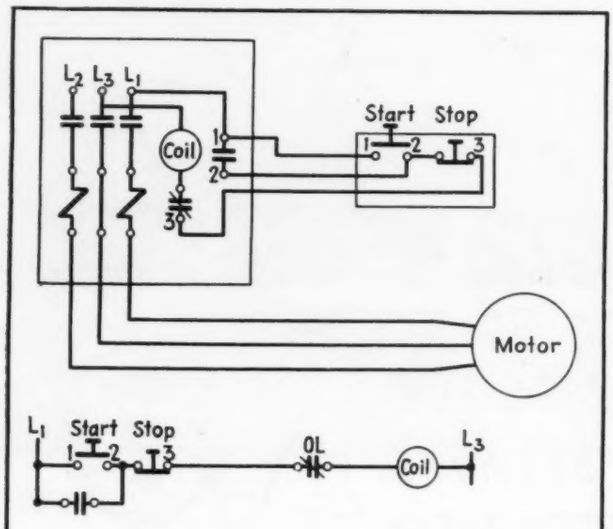


Figure 1. *Buttons:* Two momentary-contact, one closed, one open. *Circuit:* Low-voltage protection, single station. *Duty:* Start-stop

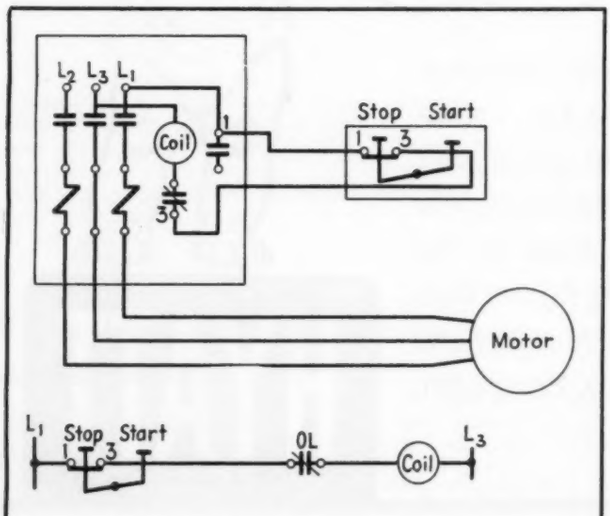


Figure 2. *Buttons:* Two maintained-contact. *Circuit:* Low-voltage release, single station. *Duty:* Start-stop

Definition of terms used with pushbutton applications afford a foundation on which to build a few basic rules. Two terms that are sometimes confusing are *low-voltage release* and *low-voltage protection*.

Low-voltage protection allows the control to be removed from the line if the power source fails or a disturbance occurs that causes the line voltage to drop to a very low value. In order to start the apparatus again, it is necessary to actuate the start button.

Control Functions Automatically

Low-voltage release, on the other hand, allows the control to drop out if for any reason the power source voltage is inadequate, but when the voltage again reaches sufficient value the control will function automatically to connect the apparatus to the line through the proper starting sequence.

In order to obtain low-voltage protection, it is necessary to have a start button that closes the control circuit only when it is being held down. An electrical interlock that is closed when the control has functioned parallels the start button and keeps the control circuit closed after the start button is released. When the control drops out because of voltage failure, the interlock opens the control circuit, thus giving protection against unsupervised starts when power returns.

These two types of control circuits, commonly known as two- and three-wire control, require different types of pushbuttons. The low-voltage release control circuit re-

(Continued on page 102)

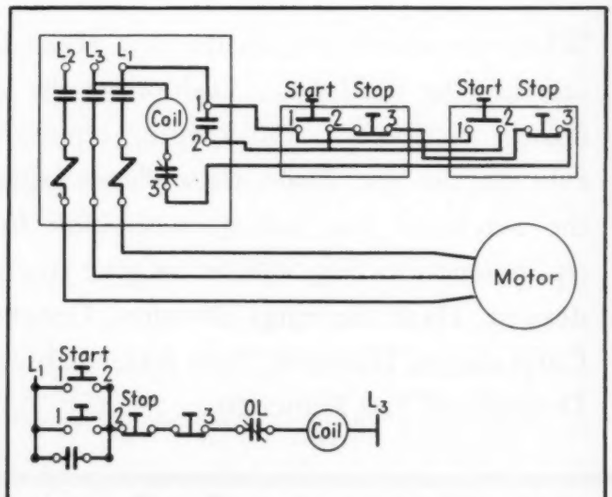
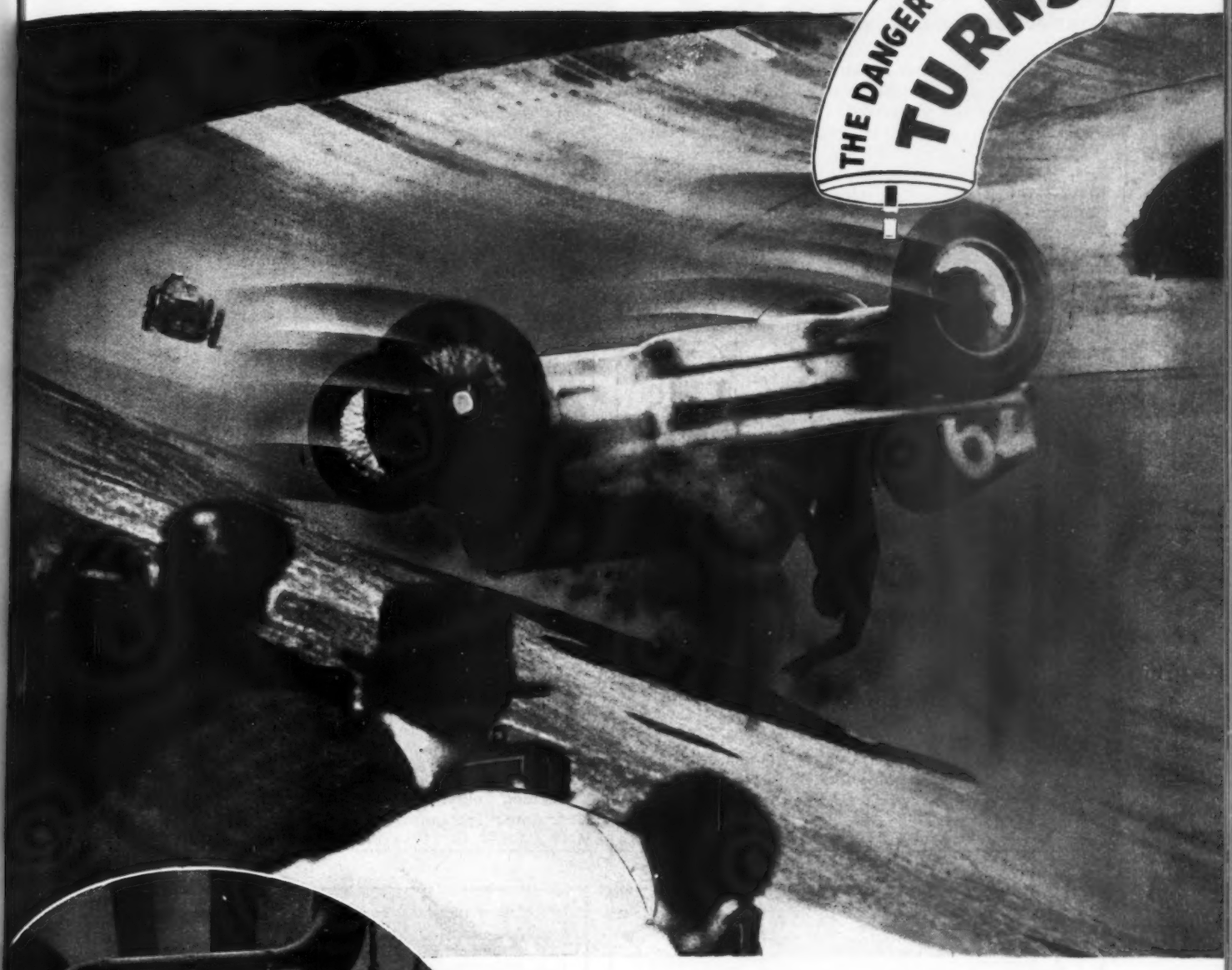
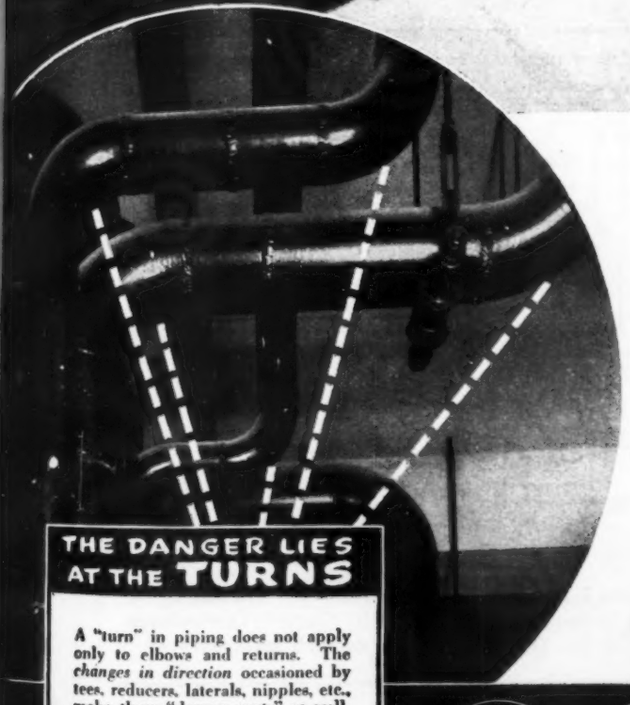


Figure 3. *Buttons:* Four momentary-contact, two closed, two open. *Circuit:* Low-voltage protection, two stations. *Duty:* Start-stop, start-stop

IN YOUR PIPING SYSTEMS, TOO . . .





THE DANGER LIES AT THE **TURNS**

A "turn" in piping does not apply only to elbows and returns. The *changes in direction* occasioned by tees, reducers, laterals, nipples, etc., make them "danger spots" as well, because of the extra friction and strain imposed on the abrupt turns within them. *Play safe* with Tube-Turns at *every* danger point.

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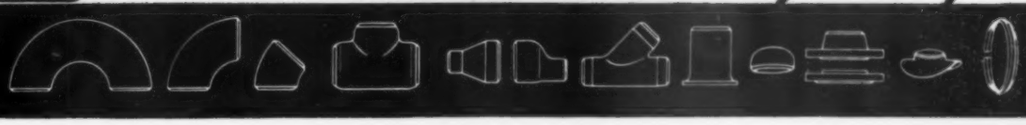


Connection Diagrams for Pushbutton Circuits *(Continued from page 100)*

quires a pushbutton that remains closed until released by hand. This type of pushbutton is known as the maintained type, and the contacts are held closed mechanically.

Low-voltage protection is secured by a momentary-contact-type pushbutton. Figure 1 shows the diagram for a low-voltage-protection pushbutton connection; Figure 2, the diagram for low-voltage release.

A control button does one of two things—it either makes a circuit or breaks a circuit. Heavy-duty pushbutton stations are arranged so that either operation or both operations can be obtained on the same unit. This ability to make or break circuits is exceedingly useful when more than just the start and stop functions are desired.

Any combination of control sequence for low-voltage protection can be obtained by applying these two fundamental rules:

1. Wire all stop buttons in series with the holding coil, with each other, and with the electrical interlock.

2. Wire all start buttons in parallel with each other and with the interlock.

Limit switches have not been included in any of the *(Continued on page 104)*

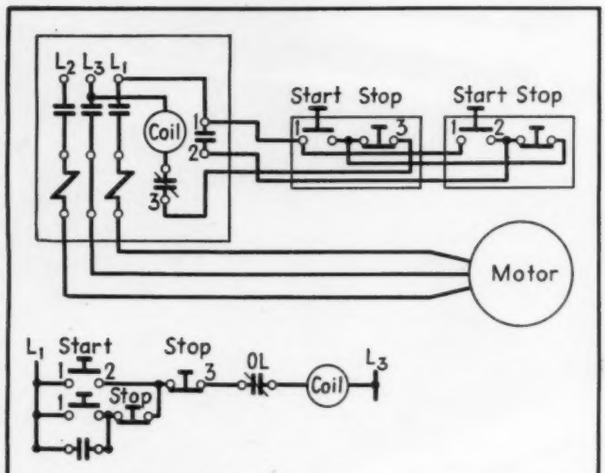


Figure 4. *Buttons:* Four momentary-contact, two open, two closed. *Circuit:* Low-voltage protection, two stations (only three wires between stations). *Duty:* Start-stop, start-stop

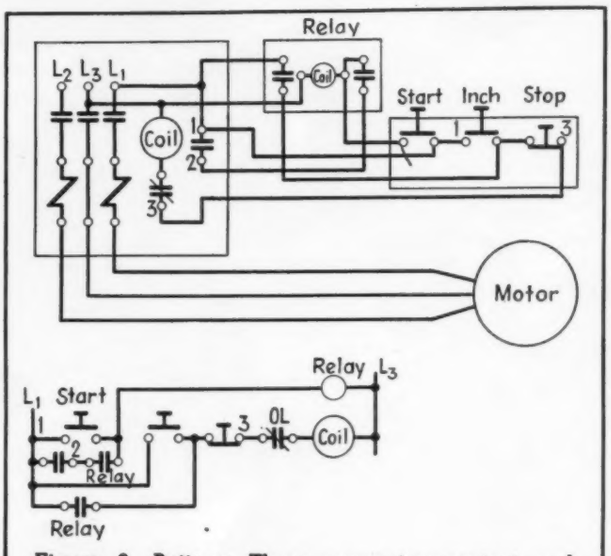


Figure 6. *Buttons:* Three momentary-contact and inching relay. *Circuit:* Low-voltage protection plus foolproof inching. *Duty:* Start-inch-stop

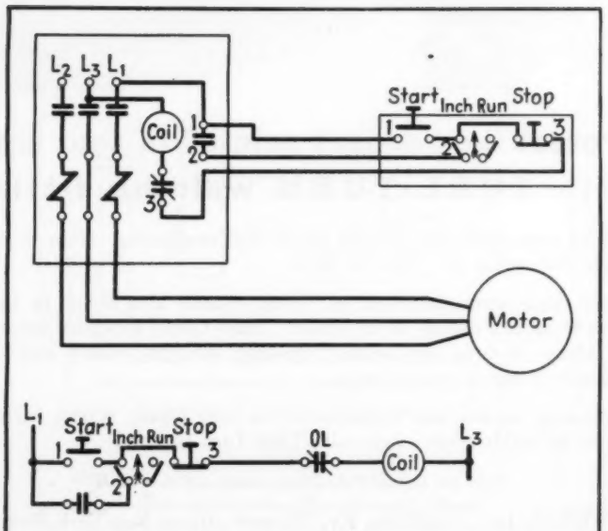


Figure 5. *Buttons:* Two momentary-contact and one selector switch. *Circuit:* Low-voltage protection plus inching. *Duty:* Start-run, inch-stop

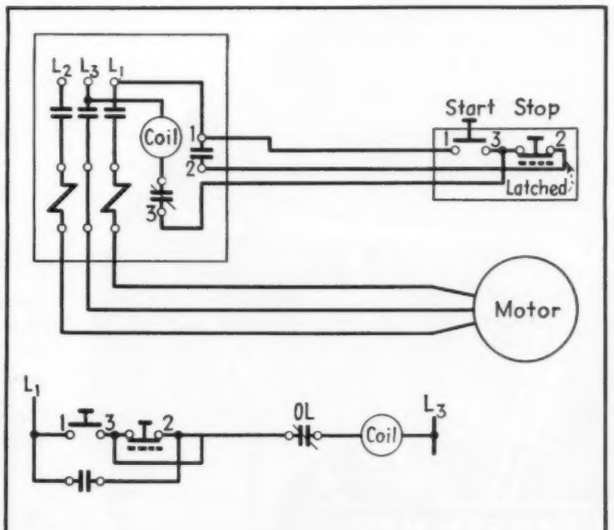
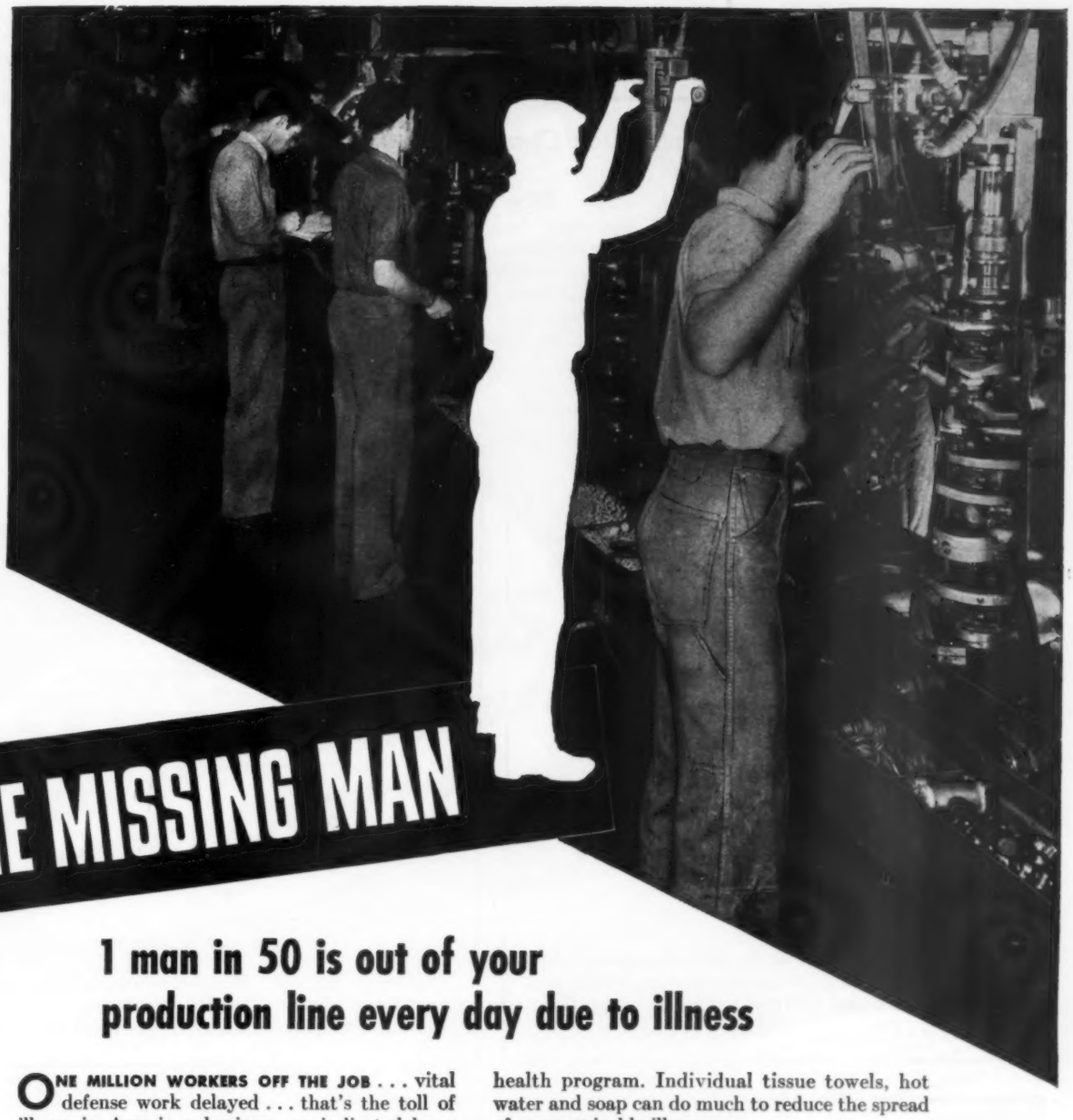


Figure 7. *Buttons:* Two momentary-contact, one open, one closed with safety latch. *Circuit:* Low-voltage protection. *Duty:* Start-stop (on inch for latch)



THE MISSING MAN

1 man in 50 is out of your production line every day due to illness

ONE MILLION WORKERS OFF THE JOB . . . vital defense work delayed . . . that's the toll of illness in American business, as indicated by a study published by the United States Public Health Service.

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92% of the firms where health programs were established reported reductions in absences in the Industrial Health Practice Survey of the National Association of Manufacturers. It was also noted that reductions in labor turnover and money savings resulted.

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INDIVIDUAL... SANITARY

Soft-Tuff

STAY TOUGH WHEN WET

ScotTissue TOWELS

Connection Diagrams for Pushbutton Circuits *(Continued from page 102)*

diagrams, although they are frequently used. These switches are governed by the same rules that apply to pushbuttons—that is, in most instances the pushbuttons can be replaced by a limit switch. Switches normally closed are similar to stop buttons, and those normally open operate as start buttons. Momentary-contact limit switches which are spring-returned give low-voltage protection, and low-voltage release is had by maintained-contact switches.

In the accompanying diagrams number *1* has been used to designate the control circuit to the start button; *2*, the point common to the start-stop button; and 3, the stop button. On some controls manufactured currently these same markings are used to aid in making common pushbutton connections. The holding interlock parallels the start button; therefore, in the schematic diagrams it is connected to points *1* and *2* of the pushbuttons.

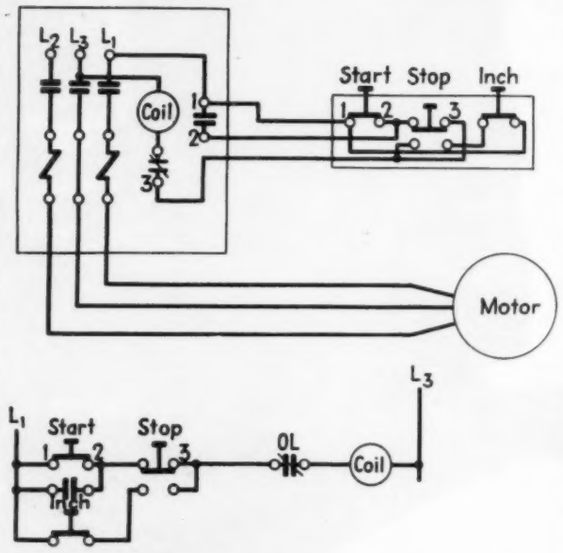

Figure 8. *Buttons:* Three momentary-contact, two open, one closed. *Circuit:* Low-voltage protection plus inching by holding down stop button. *Duty:* Start-inch-stop

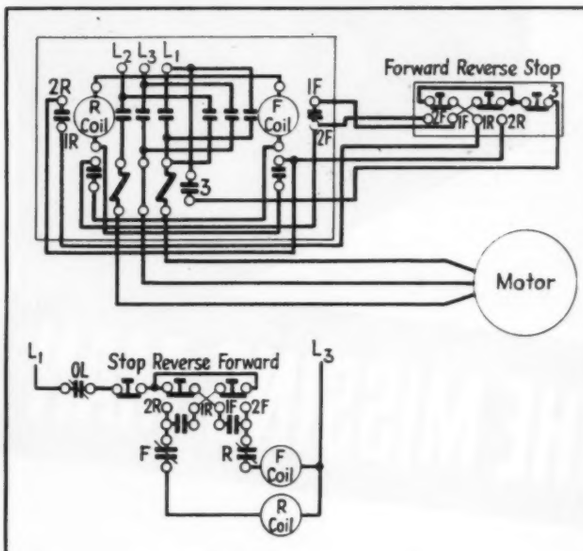

Figure 10. *Buttons:* Three momentary-contact, two open, one closed. *Circuit:* Low-voltage protection with electrical interlocks. *Duty:* Forward-reverse-stop

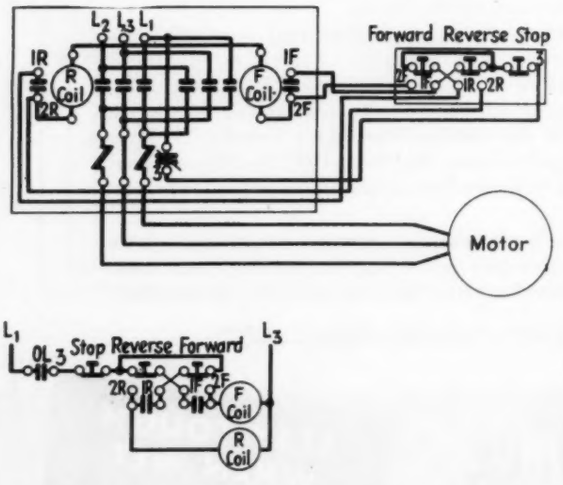

Figure 9. *Buttons:* Three momentary-contact, two open, one closed. *Circuit:* Low-voltage protection, interlocked through pushbuttons. *Duty:* Forward-reverse-stop

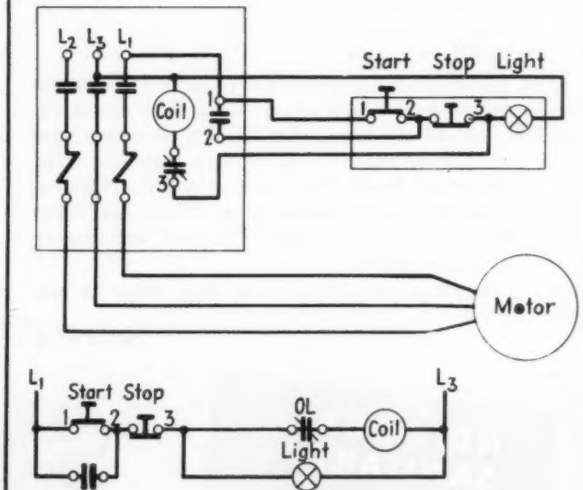

Figure 11. *Buttons:* Two momentary-contact, one indicating light. *Circuit:* Low-voltage protection. *Duty:* Start-stop

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TEN-LOX is the only anti-slip material with two sizes of abrasive that extend clear through the casting. With the combination of the large and small abrasive grits, TEN-LOX achieves the utmost in safety and durability. TEN-LOX is rust-proof and highly resistant to corrosion.

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• DOES THE SMELL of a new paint job irritate you or your employees? It needn't and won't if you use a paint deodorant which is said to completely neutralize the odor and so take out the smart. Holley Chemical Co., 122 East 25th St., New York.

• HOW TO KEEP wage and hour records in accordance with the Fair Labor Standards Act of 1938 is explained in a pamphlet covering the revised record-keeping regulations, effective as of September 15, 1941. U. S. Department of Labor, Wage and Hour Division, Washington, D. C.

• SUBSTITUTION of a new composition metal to replace aluminum foil as a food packaging material has been announced by the Display & Container Division of the Reynolds Metals Co., 19 Rector St., New York. Gold and silver backgrounds for embossed and printed labels and packages are available.

• YOU and your employees may want more information about defense savings bonds and stamps before buying any. Plain facts about them are set forth in a booklet which tells what they are and the part they play in the defense program. United States Treasury Department, Washington, D. C.

•CONCRETE FLOORS treated with a stain and paint retain their colors as the cement wears down because the stain sinks into the concrete. The surface coat is said to be unaffected by moisture or lime and to be resistant to alcohol, gasoline, and similar solvents. Four colors. The Wilbur & Williams Co., Park Square Building, Boston.

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• IF YOU ARE BUILDING for defense and want a plant that can withstand attack, you'll want to look into a 24-page bulletin of recommendations based upon European experience. Stresses importance of windows, principles of design and blackout. Detroit Steel Products Co., Engineering Research Dept., 2250 East Grand Blvd., Detroit.

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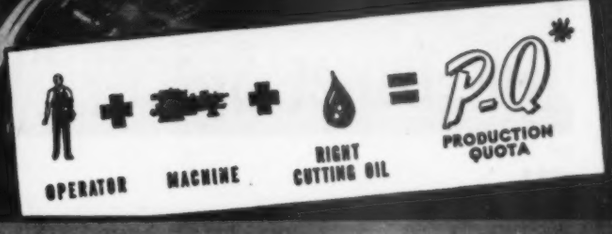
PERFORMANCE DATA

OPERATION—Finning Air Cooled Airplane Engine Cylinder.
MACHINE—Jones & Lamson Heavy Duty 16" Fay Automatic Lathe.
MATERIAL—Nitrided Steel.
TOOLS—47 H.S.S. tools in a single bank, removing 18 lbs. of metal in 7 minutes cutting time.
CUTTING LUBRICANT—Sunicut

Photo Courtesy of
JONES & LAMSON MACHINE CO.



SUN OILS

PETROLEUM PRODUCTS FOR ALL INDUSTRIES

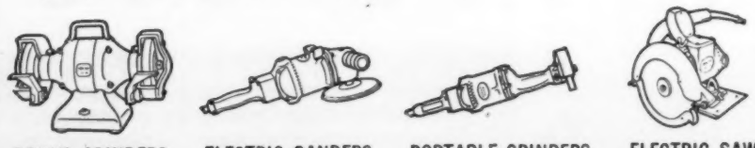
Copyright 1941 by Sun Oil Company

New Assembly Tool Data Book

FREE TO HELP YOU SPEED UP DEFENSE PRODUCTION

Send for this New Van Dorn "Power Assembly Tool Data Book!" Tells all you want to know about using Van Dorn Portable Electric Screw Drivers, Nut Runners and Tappers to speed up assembly operations on everything from delicate instruments to army tanks. Contains 56 pages, packed with photographs of actual Power Driver applications, charts, graphs, screw and bolt specifications. Covers practically every type of industrial power assembly operation.

Write *today* for your copy of Van Dorn's "Power Assembly Data Book"—keep it handy for solving power assembly questions—then ask your jobber to demonstrate the exact Van Dorn Screw Driver, Nut Runner or Tapper to put "all out" speed in *your* operations! The Van Dorn Electric Tool Co., 719 Joppa Road, Towson, Maryland.



BENCH GRINDERS ELECTRIC SANDERS PORTABLE GRINDERS ELECTRIC SAWS

"Van Dorn"

(DIV. OF BLACK & DECKER MFG. CO.)

PORTABLE ELECTRIC TOOLS

For Power Specify "Van Dorn"

facturing conditions demand freedom from sparks and resistance to the chemical action of ether, alcohol, acid, and explosives. Goodyear Tire & Rubber Co., Akron.

• WAYS of increasing factory output are told in two pamphlets concerning better production control and better use of employee skills. 75c each. American Management Association, 330 West 42nd St., New York.

• EYE-CORRECTIVE as well as eye-protective. Safety goggles for workers with defective vision are fitted with ground lenses. Seven styles include spectacle and side-shield types for different eye hazards. American Optical Co., Southbridge, Mass.

• TEN SECONDS is all the time it takes, they say, to apply an immersion tin finish to copper and brass surfaces. Enamel and glass containers are used and the work can be handled in baskets or on wire. Alrose Chemical Co., Providence.

• RATS become their own electrocutioners when they are caught in an automatic trap whose inner passages lead them into one of six electrically charged stalls. Release mechanism automatically opens outer trap door as each victim is exterminated. Looks like a wooden tunnel and is 48 in. long, 21 in. wide, and 15 in. high. Rochester Automatic Trap Co., Inc., 278 Clinton Ave., So., Rochester, N. Y.

• BLACKOUT SHEET, tough black kraft paper that sticks to the inside of factory windows, prevents escape of tell-tale light at night and keeps glass from flying when struck. A sliding, light-tight shutter is supplied for use with the sheeting applied to those windows through which light is desired in the daytime. Will be available in 50-yd. rolls 26 in. wide. U. S. Defense Materials Corp., 315 Berry St., Brooklyn, N. Y.

• PLASTIC has been shaded in three colors to reduce glare and eyestrain to a minimum. Designed particularly for use on a redesigned recording instrument chart, it can be cleaned and re-used indefinitely. Permochart Co., 450 Chestnut Road, Sewickley, Pa.

• STATISTICAL AND GRAPHIC summary of data relating to federal, state, and local finances—tax collections, public expenditures, and public debt—is contained in a 73-page booklet, "Tax Facts and Figures," which compares the fiscal situation of 1914 with that of 1940. Single copy, $1. Tax Foundation, 30 Rockefeller Plaza, New York.

• COMMENTS of various executives on quality control, subcontracting, and training are contained in a pamphlet entitled "Defense Production Problems." 50c. American Management Association, 330 West 42nd St., New York.

HANDLE GOODS FASTER

with easily-maneuvered Electric Fork Trucks— one of 6 distinct types built by Elwell-Parker

A single job out of many—but how important *this* one of using Elwell-Parker Electric Fork Trucks to get materials out of and into freight cars and *into your production* without a moment's lost time!

Or *into storage!* Elwell-Parker Fork Trucks, high-tiering pallet- or skid-loads in boxes, barrels, bags and bales, save owners' time, floor space, ground rents, taxes. They literally cram warehouses to the limit with pay loads, tiering filled pallets one on another to roof girders.

Center Control Fork Trucks (above) are matched by equally modern Elwell-Parker End Control Units. Attachments include telescoping uprights; lifting-tiering-tilting; and interchangeable rams, forks, booms, roll-handling aprons, upenders and scoops.

Furthermore, Elwell-Parker builds Platform Trucks, Lift Trucks, Cranes, Tractors and Load Carriers—comprising *Systems* of Load Transportation best adapted to handling your volume loads at large new savings.

The Elwell-Parker Electric Company, 4323 St. Clair Avenue, Cleveland, Ohio.

ELWELL-PARKER *Power Industrial* **TRUCKS**

ESTABLISHED 1893 • BUILDING POWER INDUSTRIAL TRUCKS SINCE 1906

THE GREATEST TIME, SPACE AND MONEY SAVING COMPRESSOR IDEA OF THE PAST DECADE...

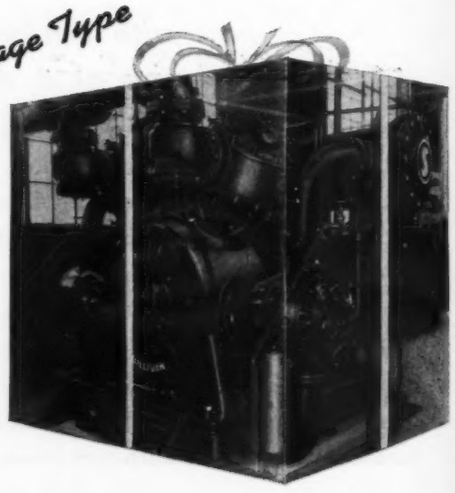
Package Type

Package Type

A WN-112 Two Cylinder Package Type Compressor in a smaller plant. Displacement from 378 to 1828 C.F.M. The largest two-cylinder Package Type Compressor requires a maximum space of 8 feet long and 6 feet 8 inches wide; foundation length 4 feet 2 inches; width 2 feet 11 inches.

Package Type

Package Type



Here are three of the Sullivan WN-114 Four Cylinder Package Type Compressors installed in plants engaged in crucial defense manufacture. The WN-114 is made in four sizes, single or twin units. 175 to 600 h.p. From 1284 to 3656 C.F.M. Maximum space required for the largest WN-114 is 9 feet long, and 9 feet 8½ inches wide; maximum foundation space: length 7 feet 9 inches; width 5 feet 3 inches.

SULLIVAN *Air* COMPRESSORS

SULLIVAN *Package Type* COMPRESSOR

Although the Sullivan Package Type Compressor has been fully proved in service, although it already has hundreds of enthusiastic users among leading industrials . . . it is so pat an answer to the crucial problem facing industry right now that it might have been devised only yesterday.

The Sullivan Package Type Compressor can best be described as "air in a hurry." It is delivered to your door complete and assembled, ready to set up. Many times it has been on the line 24 hours after its arrival. It is so compact it requires only half as much space as the old style, bulky compressor. It is so modern and perfectly balanced in construction that it requires only 1/5th or 1/6th the usual foundation of the older type compressor.

Moreover, it is made in capacities and operating characteristics to fit almost any need—from 378 up to 3656 cubic feet per minute.

It embodies the most modern ideas in compressor design, metallurgical science and machine techniques, thoroughly tested and thoroughly proven. No casting of less than 35,000 lbs. per square inch tensile strength is used in Package Type Compressors. Sullivan is the *only* compressor making such extensive use of modern high tensile alloys such as Hytenite, Meehanite and Mocasco.

Whatever your needs may be, you owe it to yourself to have a clear picture of the greatest money, time and space saving compressor idea of a decade—the Package Type Compressor. Write for descriptive bulletin A-38 or send your specifications.

SULLIVAN PACKAGE TYPE Compressors are two-stage, double acting, long-lived, heavy duty, continuous service compressors—much smaller than old style compressors of the same capacity—and yet have operating economies equal to or exceeding those of the older bulky units of the same capacity. PACKAGE TYPE compressors need only to be hooked up to power, water and air lines and they are ready for 24-hour per day constant and efficient service. They are particularly suitable for synchronous motor drive and extremely well adapted for drive from steam turbines or diesel engines.

Package Type

The Unitair Package Type Compressor, smallest of this class of compressors. Two-stage, single-acting, air cooled. For small manufacturing plants, standby service and similar application. Overall dimensions, smallest size 2 ft. 11 in. x 3 ft. 8 in. Largest size 3 ft. 8 in. x 5 ft. Capacities from 107 C.F.M. to 438 C.F.M.

Package Type

Twin unit of the WN-112 Two Cylinder Package Type Compressor, both units being driven by the same synchronous motor.

Ninetieth 90th ANNIVERSARY 1851 1941

SULLIVAN MACHINERY COMPANY *Executive Offices:* MICHIGAN CITY, INDIANA

FACTORIES: MICHIGAN CITY, IND. • CLAREMONT, N. H. • DUNDAS, ONT. • GRANTHAM, ENG.

Associated House: Canadian Sullivan Machinery Company, Ltd., Dundas, Ontario

OFFICES

BOSTON - - 104 Brookline Ave.
CHICAGO - 307 No. Michigan Ave.
NEW YORK - - - 30 Church St.
PITTSBURGH - - 47 Terminal Way
ST. LOUIS - - - 2639 Locust St.
SAN FRANCISCO - - 145 10th St.
LOS ANGELES - 2900 Santa Fe Ave.
DETROIT - 2051 W. LaFayette Ave.

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PRODUCTS

HEAVY DUTY, SINGLE OR TWO STAGE STATIONARY AIR COMPRESSORS IN ANGLE, V-VERTICAL, VERTICAL OR HORIZONTAL TYPES IN SIZES FROM ¼ TO 3000 H. P. ALSO A COMPLETE LINE OF PORTABLE COMPRESSORS

Champion Lamps are lamps you can trust. Made since 1900 by an organization of specialists in this one field, they are products of *controlled quality.* You can buy them with confidence, knowing that there are no better lamps, no better lamp values. It pays to specify Champions. Ask your regular supply house about them.

Champion lamps are licensed under General Electric Co. incandescent and fluorescent lamp patents.

CHAMPION LAMP WORKS

Lynn, Massachusetts

A DIVISION OF CONSOLIDATED ELECTRIC LAMP CO.

TRADE **AUTOMATIC** MARK

Manufacturers for Over Thirty Years

Electric Propelled **INDUSTRIAL TRUCKS**

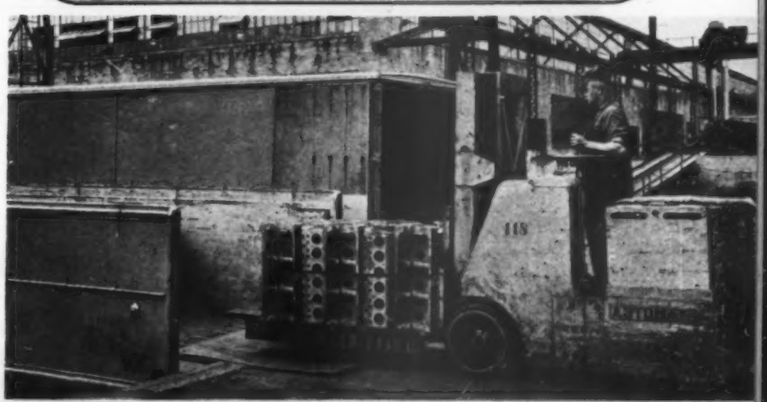
Listed Under Reexamination Service of UNDERWRITERS' LABORATORIES

"AUTOMATIC" FORK TRUCK PALLET SYSTEMS PROVIDE GREATEST EFFICIENCY AND LOW UNIT COST HANDLING OF METAL PARTS

The scene above shows a section of the 1200 foot long outside storage area where unit loads of metal parts such as engine blocks are stacked three high on either side of aisle. Incoming motor trucks are loaded with metal parts strapped to pallets as unit loads averaging 3000 to 5000 pounds. These are transported with dispatch to storage areas by "AUTOMATIC" fork trucks thus facilitating quick unloading of a fleet of such motor trucks with minimum delay.

Storage of parts are either outside of assembly building or directly inside. As material is required for production "AUTOMATIC" fork trucks provide a flexible transportation system to such departments. Empty pallets are returned to shippers thus reducing the investment in unit load carriers.

This method of operation keeps production at highest peak, eliminates bottlenecks and provides a flexible transportation and stacking system resulting in controlled inventory and low handling cost per unit. Write for full details and prices without obligation.

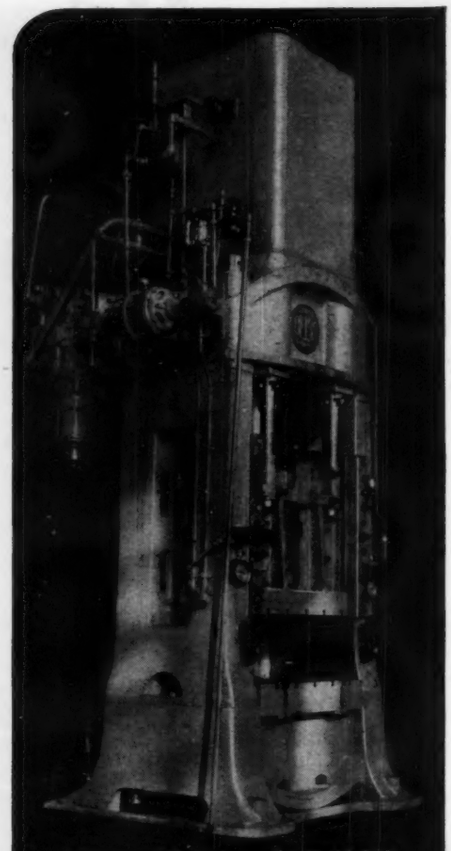


AUTOMATIC TRANSPORTATION COMPANY

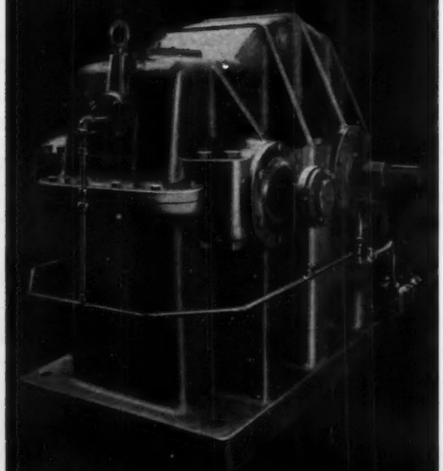
DIV. OF THE YALE & TOWNE MFG. CO.

39 W. 87TH ST. CHICAGO, ILL.

WHEN YOU BUY TRUCKS · · *Buy* "AUTOMATIC"



A Harrison Oil Cooler model HE 116-203 regulates oil temperature on this 50-ton Bliss hydraulic press.



Guarding against the danger of too-high operating temperature on this Westinghouse speed increaser is a Harrison Oil Cooler model 250-200.

Size 4" S., 8-stage Pacific pump equipped with Harrison Oil Cooler model HE-60.

HARRISON

OIL COOLERS
STEP UP MACHINE OUTPUT

In the final analysis, the success of America's defense production program depends on the efficiency with which each machine does its job.

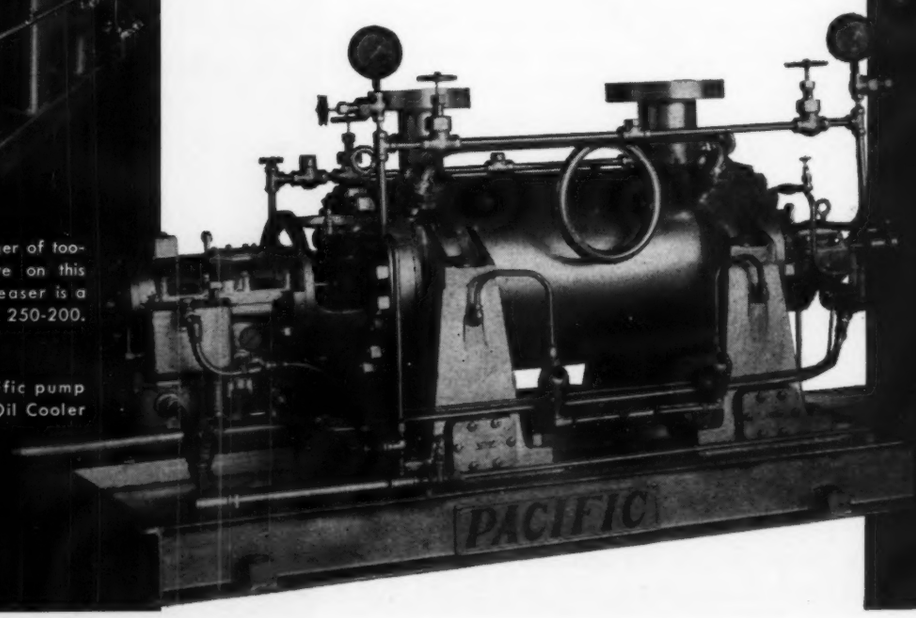
Harrison Oil Coolers provide a specific means of increasing that efficiency. By maintaining lube oil temperatures within the range required for proper lubrication, they permit high-speed, long-hour operation and reduce interruptions for maintenance.

Harrison Oil Coolers are compact in design, rugged in construction, and available in sizes, types and models to meet various industrial requirements. Harrison engineers are qualified to help you on all problems involving machine temperature regulation.

HARRISON

RADIATOR DIVISION

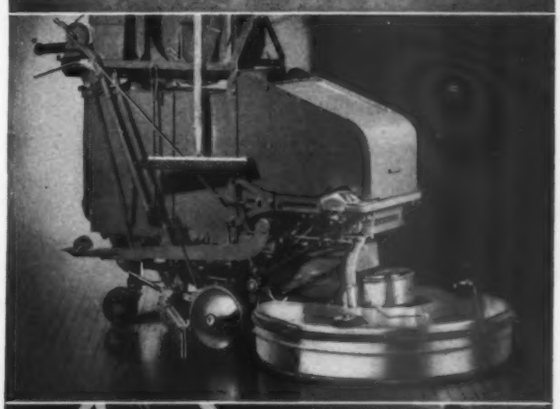
General Motors Corporation, Lockport, New York

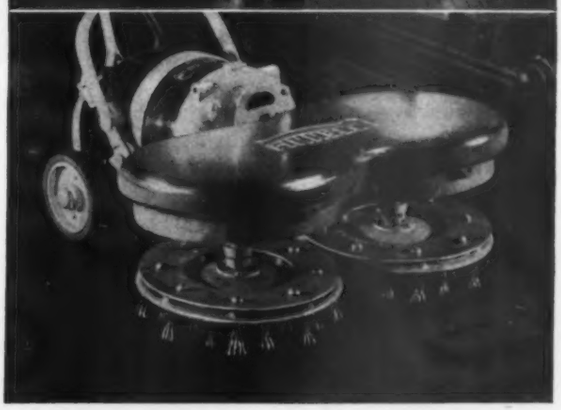


PREPARED

☆☆☆ TO SOLVE
Individual
FLOOR-MAINTENANCE
PROBLEMS

SEVEN OF THE 49 *Job-Fitted* FINNELLS





Floors have individuality, the same as people! And different types of floors present different problems of maintenance.

Yours may be a safety problem, and you want to know how to remove stubborn accumulations of dirt, shavings, oil, grease and other slippery substances that menace the safety of your men and defense production. Or, perhaps you have a floor that's hard to clean because of narrow aisles and cluttered machinery . . . or a large open-area floor for which maintenance is far too costly under present methods.

Whatever your individual floor-maintenance problem, *Finnell* can help you. With equipment in a range of 49 different models and sizes, *Finnell* is well prepared to serve the varied needs of industry . . . to supply exactly the equipment *you* need for the most efficient and most economical maintenance of your particular floors.

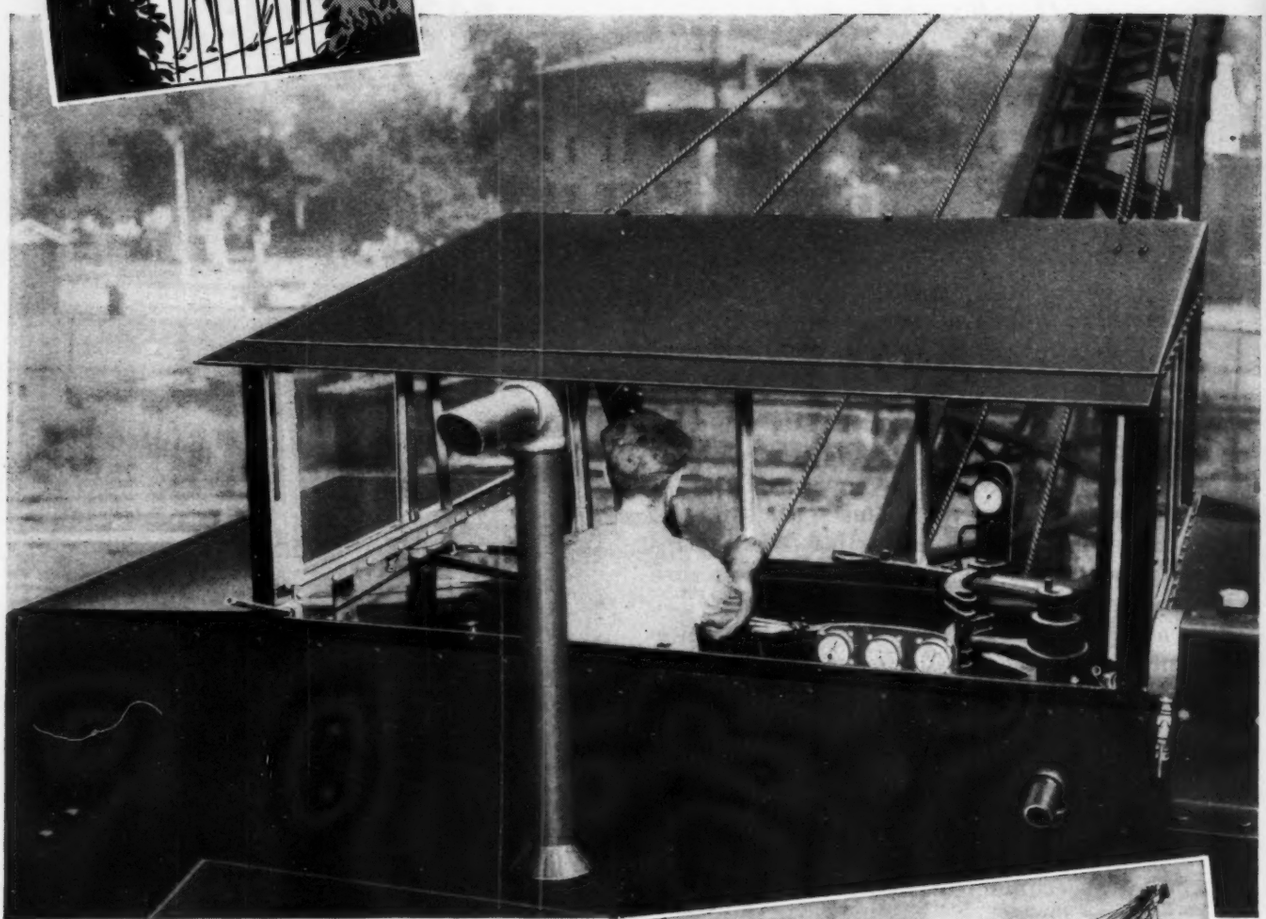
Get the full facts about *Finnell Job-Fitted Equipment.* You will profit by it! For consultation, free floor survey, demonstration, or literature, phone nearest *Finnell* branch, or write Finnell System, Inc., 2510 East Street, Elkhart, Indiana.

A Cordial Welcome Awaits You at the Finnell Exhibit
— 30th National Safety Congress and Exposition — Chicago
October 6-10 — Space 70

FINNELL SYSTEM, INC.

Pioneers and Specialists in FLOOR MAINTENANCE EQUIPMENT

Clear View in Every Direction from Industrial Brownhoist Monitor-Type Cab



The new patented Monitor-type cab, an exclusive feature on Industrial Brownhoist gasoline or Diesel locomotive cranes from 10 through 40 tons, enables the operator to see clearly in every direction—with no effort whatsoever. In addition this cab insures less noise and better ventilation. Write for complete facts to Industrial Brownhoist Corporation, Bay City, Michigan, or to any of the district offices in New York, Philadelphia, Pittsburgh, Cleveland, Chicago.

INDUSTRIAL BROWNHOIST BUILDS BETTER CRANES

GENERAL OFFICES: BAY CITY, MICHIGAN • DISTRICT OFFICES: NEW YORK, PHILADELPHIA, PITTSBURGH, CLEVELAND, CHICAGO

MASTER

SPEEDRANGER

This variable speed drive combines all the advantages of an all-metal construction, resulting in extreme compactness, infinitely variable speed, proven durability and economical operation.

ALL-METAL. The all-metal construction insures long life and the greatest possible freedom from interruptions to service. The design is extremely simple, consisting of a metal ring which operates at a variable position on the two driving and two driven cones. The position of the ring on the cones determines the speed of the output shaft.

SIMPLE COMPACT DESIGN. Only with an all-metal drive is it possible to secure the compactness, simplicity, flexibility and economy that are so advantageous on modern production machines and processes.

INFINITELY VARIABLE SPEED. The output speed may be increased or decreased instantly, at the turn of the hand wheel, to any R.P.M. within the range of the unit. This change in speed can be made at any time, while the unit is at rest or in motion.

PROVEN RELIABILITY. Millions of hours of service in the field under actual operating conditions, and exhaustive tests in the laboratory have proven conclusively the complete reliability of this device.

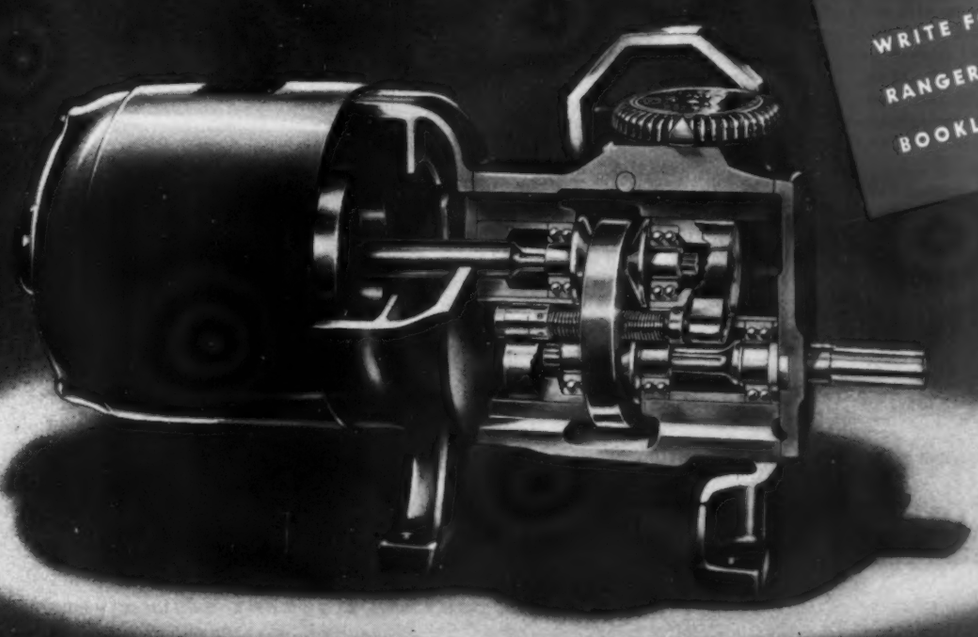
AVAILABLE WITH ALL TYPE MOTORS. The Master Speedranger is available in the vast number of types that make up the complete Master line.

HORSEPOWER. Now available in sizes up to and including 3 horsepower.

SPEED RANGES. Three different ranges—3 to 1, 6 to 1 and 9 to 1 are available.

THE MASTER ELECTRIC COMPANY • DAYTON • OHIO

WRITE FOR A SPEED-RANGER DESCRIPTIVE BOOKLET DATA 7525B



JOHNSON FINISHED BRONZE BEARINGS

HUNDREDS OF DIFFERENT SIZES

IN STOCK FOR IMMEDIATE DELIVERY

Specify

JOHNSON

General Purpose

BEARINGS

Are you having trouble in securing your needs in plain, cast bronze bearings? Perhaps, we can help you . . . with uniform, high quality bronze . . . machine finished, ready for assembly . . . delivered from stock!

Simply compare your sizes with our stock list. Chances are ten to one that —from our more than 800 sizes—we can fill your order right off the shelf.

Johnson GENERAL PURPOSE Bearings are cast in S.A.E. 64—the favorite alloy of engineers, designers and maintenance men everywhere.

Twenty-two fully stocked, strategically located warehouses plus hundreds of distributors are ready to serve you. Write for a copy of our new catalogue TODAY.

JOHNSON BRONZE

Sleeve Bearing Headquarters

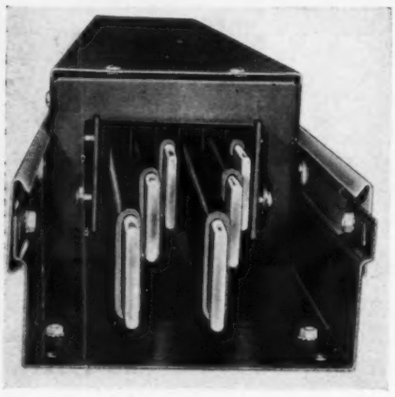
512 S. Mill St., New Castle, Pa.

Specify JOHNSON BRONZE

WHAT'S NEW IN EQUIPMENT

Low Voltage Drop Buss-Wa

Newly designed L.V.D. (low voltage drop) Buss-Wa has specific advantages in design and performance that, it is claimed, will speed production, conserve power, save time and cost. Low voltage drop



in this new, flexible distribution system is the result of a new principle in the design and spacing of conductors, with every detail of the construction and insulation accurately balanced to reduce the reactance value of the circuit.

Mechanical strength and bracing of conductors are amply heavy to prevent failure under mechanical stress due to short circuit conditions which may occur with the general use of low-impedance, high-capacity transformers.

Other adantages claimed, are ease and quickness of installation, safety to personnel and plant equipment, assurance of uninterrupted power flow under all load conditions. The Trumbull Electric Mfg. Co., Plainville, Conn.

"Dry" Oils for Industrial Use

Known as Van Caloria, oils containing colloidal graphite and designed for high-temperature lubrication (above 400 deg. F.) have been added to line of industrial lubricants announced by Esso Marketers. These lubricants are being distributed by Standard Oil Companies of New Jersey, Pennsylvania, and Louisiana; the Colonial Beacon Oil Company; and Penola, Inc.

Under the high temperatures for which the lubricants are designed, the oil gradually vaporizes leaving no residue from the oil itself, but only a fine film of dry colloidal graphite.

Under friction and heat this graphitic film is adsorbed by the surface material, forming what is known technically as a graphoid surface. Lubrication from that point on is entirely "dry" until the supply of oil is renewed. Thus the graphite prevents actual metal-to-metal contact. Available in several viscosities to suit varying lubricating conditions and methods. The oils range in viscosity from light-bodied liquids to highly viscous types. May be applied by any of the conventional methods, including spray, oilcan, mechanical lubricator, pressure gun, depending on the design of equipment and operating conditions.

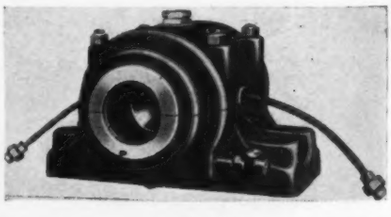
Lamp Changer

A safe, handy device for removing and replacing light bulbs without a ladder has recently been announced. The average person can easily reach up to 20 feet high with the Ideal lamp changer fitted with an extension pole, and remove or replace standard lamp bulbs from stationary or rigid sockets, where bulbs are not entirely surrounded by globes or wire protection. Changer grips bulbs suspended on pipes (or hollow tubes) as well as those in ceiling sockets. Consists of a rubber suction cup mounted on one end of a lightweight pole. Grip of the suction cup is obtained by pushing it against bottom of bulb, and released by pulling a cord attached to lip of cup. Suction cup is of high-grade, specially molded rubber. Available with 4- and 7-ft. poles as well as an 8-ft. grooved extension pole. Ideal Commutator Dresser Co., 1416 Park Ave., Sycamore, Illinois.

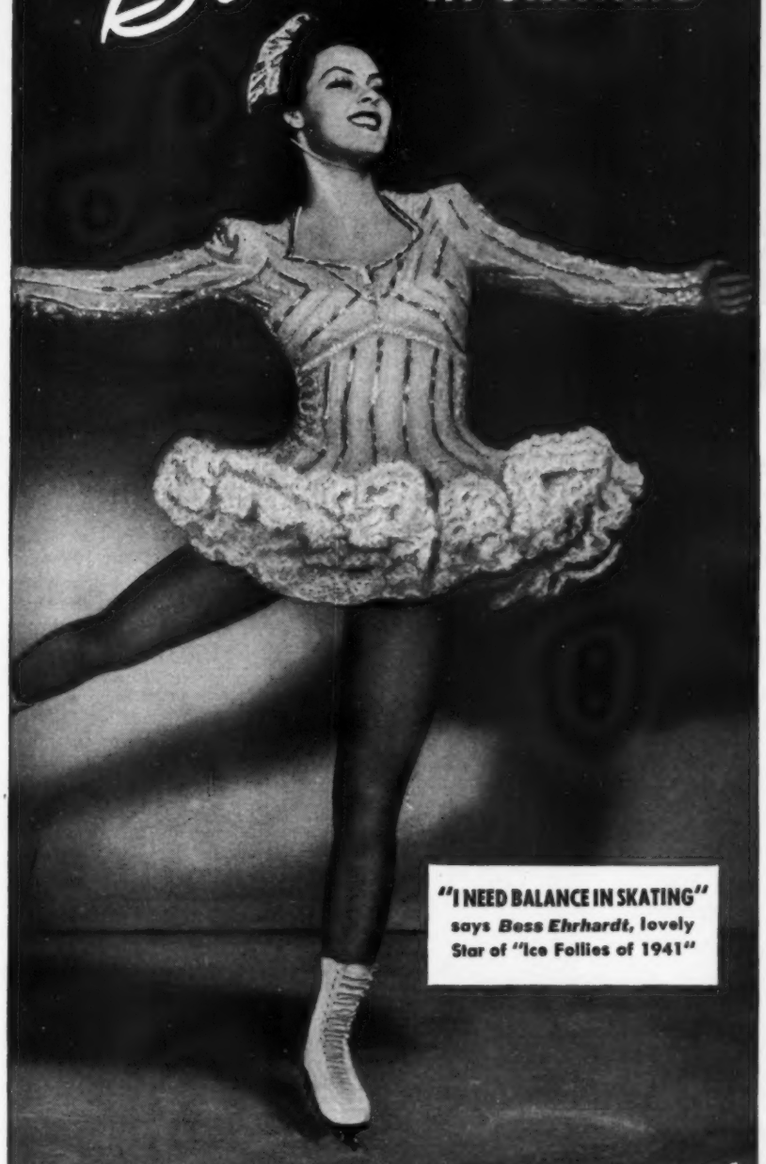
Precision Pillow Block

Sleevoil precision pillow blocks, plain and water-cooled types, shaft sizes from $1\frac{7}{16}$ in. to 8 in. inclusive, are designed for a wide range of industrial applications where a high-grade babbitted bearing is required. Lubrication is provided by the use of T section brass oiling rings. Single rings are furnished in sizes up to $3\frac{7}{16}$ in. Two rings are used in larger sizes. A brass oil gage is provided that can be placed on either side of the bearing and by the use of additional $\frac{1}{4}$-in. pipe can be extended to any distance from the bearing. Bases have drain holes in each end, and caps are provided with inspection hole and cover.

Bearings are self-aligning and can be furnished in either expansion or non-expansion types. Expansion pillow blocks have no provision for thrust loads, but

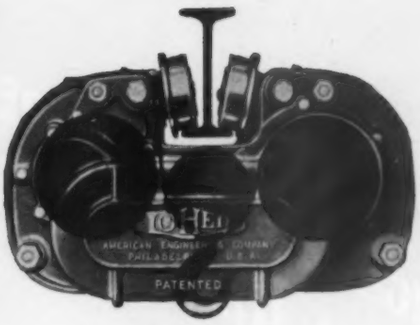


I NEED *Balance* IN SKATING



"I NEED BALANCE IN SKATING" says *Bess Ehrhardt*, lovely Star of "Ice Follies of 1941"

AMERICAN ENGINEERING COMPANY



You Need BALANCE in a HOIST

LO-HED, the *Balanced* Hoist. It's balance that makes the difference between a Lo-Hed and any other hoist. In this different hoist the motor and drum are on opposite sides of the beam. The hook goes up so close to the beam you can scarcely jam your thumb between. You get a compact, balanced hoist, minimum headroom, efficient spur gearing, and a sturdy frame, plus all the practical features a hoist should have. A Lo-Hed is worth a few dollars more but it will make a difference in your operating and maintenance costs. Look at a Lo-Hed and you won't have to look further. Write for Lo-Hed catalog today.

LOOK AT THE BALANCED LO-HED!

It Costs Less To Operate—All gears are efficient stub-tooth spur gears running in a sealed oil bath . . . gear shafts and trolley wheels are equipped with heavy-duty ball or roller bearings.

It Costs Less To Maintain—Sturdy construction . . . seldom, if ever, requires removal from rail . . . covers of controller, motor, drum and gearing are easily removed.

It's Safe—Factor of safety of over 5 at full capacity . . . 100% Positive Automatic Stop when load reaches upper limit . . . Automatic Holding Brake prevents load from drifting when current is shut off . . . short, strong shafts minimize torsional stresses.

It's Protected—Controller is fire, dust and moisture proof . . . motor totally enclosed . . . gearing sealed in . . . motor and drum covered by easily removable covers.

The Lo-Hed Hoist Is Applicable To Any Monorail System
There's A Balanced Lo-Hed Electric Hoist For Every Purpose

OTHER A-E-CO PRODUCTS: TAYLOR STOKERS, MARINE DECK AUXILIARIES, HELE-SHAW FLUID POWER

Look in your Classified Telephone Directory under "A-E-CO LO-HED HOISTS" for your nearest representative.

AMERICAN ENGINEERING COMPANY
2426 Aramingo Avenue, Philadelphia

☐ Please send me your complete catalog of LO-HED HOISTS.
☐ Ask your representative to get in touch with me promptly.

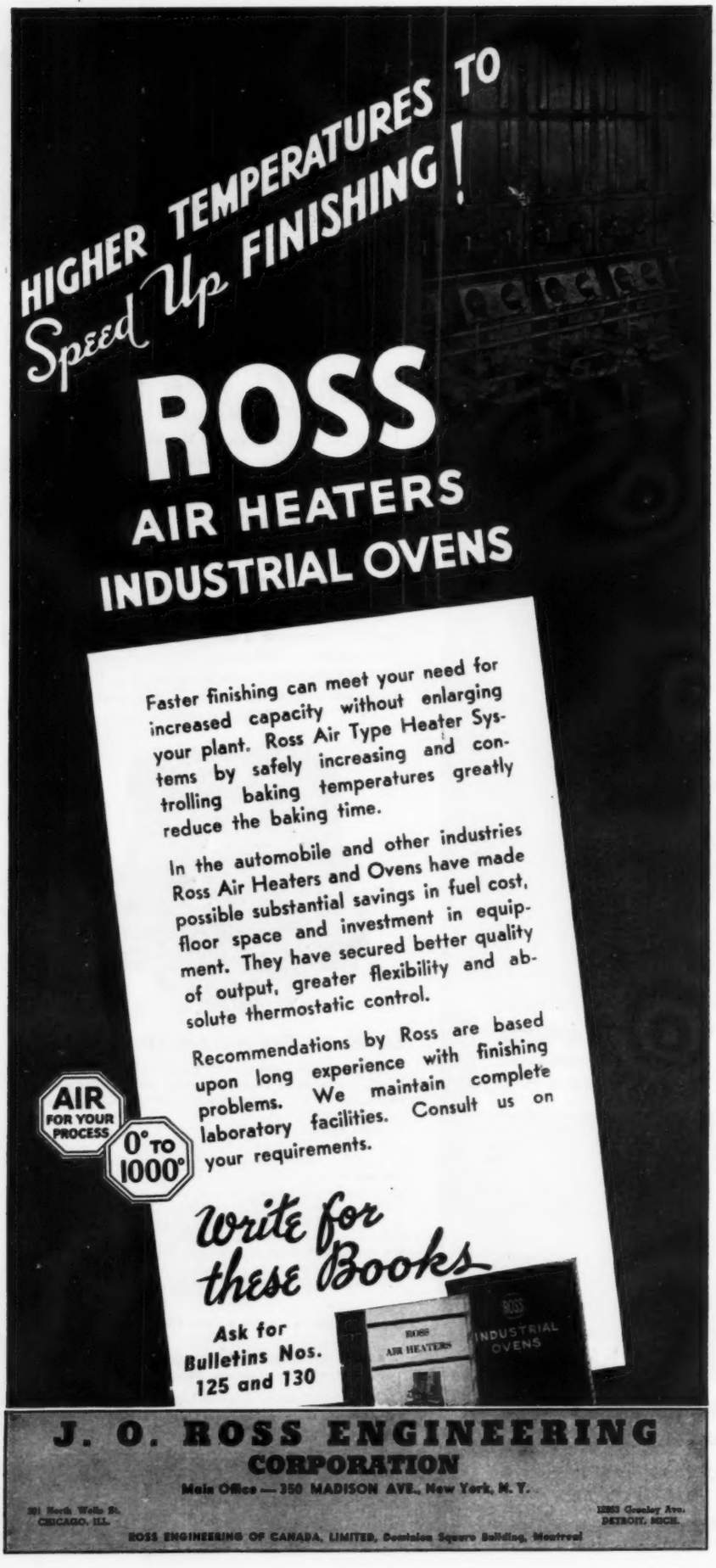
Name_____

Company_____

Street Address_____

City_____ State_____

(Please print plainly)


HIGHER TEMPERATURES TO
Speed Up FINISHING!
ROSS
AIR HEATERS
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Faster finishing can meet your need for increased capacity without enlarging your plant. Ross Air Type Heater Systems by safely increasing and controlling baking temperatures greatly reduce the baking time.
In the automobile and other industries Ross Air Heaters and Ovens have made possible substantial savings in fuel cost, floor space and investment in equipment. They have secured better quality of output, greater flexibility and absolute thermostatic control.
Recommendations by Ross are based upon long experience with finishing problems. We maintain complete laboratory facilities. Consult us on your requirements.
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Main Office — 350 MADISON AVE., New York, N. Y.
CHICAGO, ILL.
DETROIT, MICH.
ROSS ENGINEERING OF CANADA, LIMITED, Dominion Square Building, Montreal

the non-expansion bearings are supplied with two internal split thrust collars.

Sealing against dirt or escape of lubricant is provided by seals held onto the shaft by garter springs. A drain at the bottom of the seal grooves carries oil back to the oil chamber. Sizes up to and including $3\frac{15}{16}$ in. are water-cooled in the lower liner only and have one flexible inlet and one outlet connection. Sizes $4\frac{1}{16}$ in. and larger are water-cooled in both upper and lower liners and have two flexible inlet and two outlet connections.

Both plain and water-cooled types are regularly carried in stock in sizes up to and including $3\frac{15}{16}$ inch. Dodge Manufacturing Corp., Mishawaka, Ind.

Electrode Holder

Among the features of a recently announced electrode holder are: Special alloy metal jaws, designed to permit easy access to small work; large area of contact between jaws and electrode; lower jaw and handle designed to permit efficient ventilation; extended lever on upper jaw to permit operator to release stub of used electrode without changing position of hand. U. S. Electric Welder Corp., 1224 W. Bancroft St., Toledo.

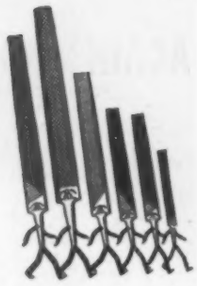
Drafting Machine

Built to hairline accuracy, True Line drafting machine embodies the following instruments used to make a drawing—protractor, vernier, T-square, scales, and triangles. Easily operated and eliminates smudging and blurring caused by moving instruments over the drawing. Equipped with "quick flick" controls. A flick of the thumb and the scales are released for 15-deg. automatic stops, or for intermediate stops and locking. Or scale can be set at any angle with a protractor and vernier reading of zero to zero. Design permits the use of the instrument with the elbow to the left or right. Protractor may be used at any angle in the complete circle. All parts subject to wear are made of hardened steel. Index plate subject to the greatest wear is notched to take up wear automatically. The Frederick Post Co., Hamlin and Avondale Aves., Chicago.

Communication System

Philco Phone communication system for inter-room conversation is designed with one master station and one remote station, supplements Philco Phone model 908 which provides two-way communication between a master station and as many as five remote stations in other departments. Master station of the new model is inclosed in compact plastic cabinet. The combination speaker-microphone, controlled by a "talk-listen" switch, permits instant conversation with the remote station at any time. This switch has a "quiet" position to which it automatically returns at the end of each conversation. Volume can be adjusted as desired. Remote station unit is a

They help to "KEEP 'EM FLYING"



IN THE great airplane factories, and at Army, Navy and commercial air fields, you will probably see Nicholson or Black Diamond files in use. For here accuracy and efficiency are "musts." And since speed, under defense demands, is now an added requirement, the Nicholson guarantee of Twelve perfect files in every dozen is more of a buying guide than ever.

With more than 3000 kinds, cuts and sizes of Nicholson and Black Diamond files, plus a force of willing field-service men, Nicholson is prepared and glad to aid industrial production managements in the selection, use and care of The right file for the job. Contact us through your mill-supply house.

NICHOLSON FILE CO. • PROVIDENCE, R. I., U. S. A.

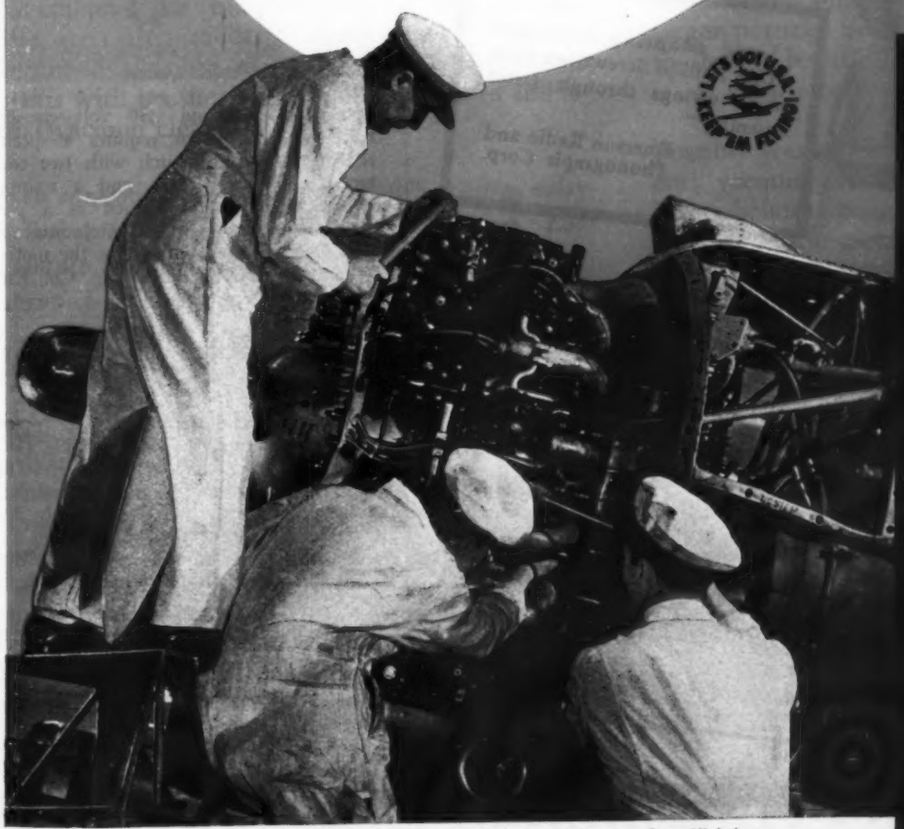
(Also Canadian Plant, Port Hope, Ont.)

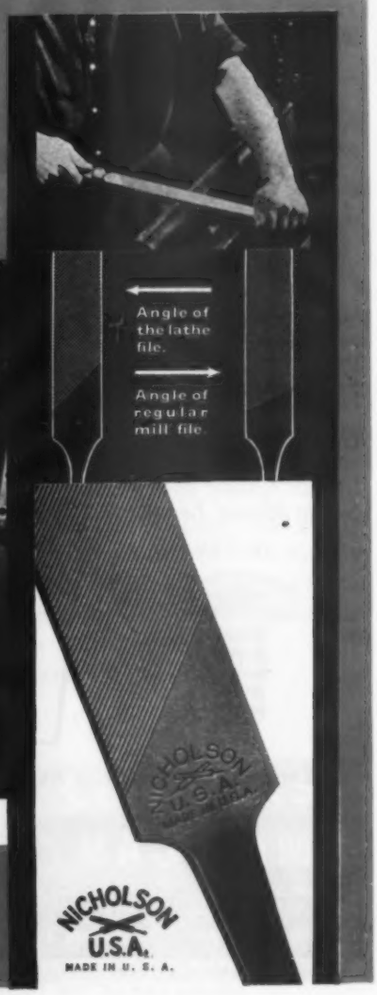
SPECIAL-PURPOSE FILES FOR SPEED AND EFFICIENCY

For Stainless Steel, Aluminum, Brass, Dies, Die Castings, Foundry Castings, Shear-Tooth and Lathe filing, Nicholson has designed special-cut files based on the requirements of various metals, production methods and finishes. Example:

LATHE FILE *(below)*—Long-angle cut provides a clean-shearing, self-clearing file that eliminates drag or tear, overcomes chatter, reduces clogging. Fast-cutting; and a light touch brings the work to a fine, silken-smooth finish. Safe edges protect shoulders and the dog.

• ***FREE TECHNICAL BULLETIN*** *on any of above-mentioned files.*





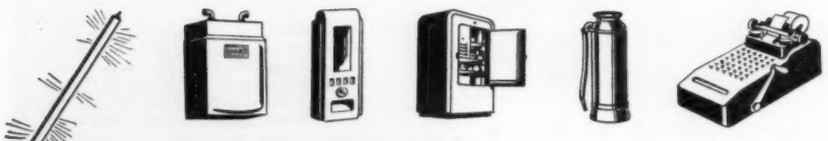
• *Photo by courtesy of United Air Lines — in whose maintenance shops Nicholson files are specified exclusively for vital work on airplane engines, propellers, etc.*

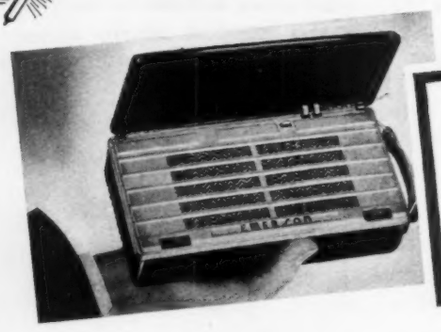
NICHOLSON FILES
FOR EVERY PURPOSE

AGAIN AND AGAIN, THEY PICK AMERICAN

Plus!

. . . to save 50% in assembly time, a saving you, too, can make





"Since adopting American PLUS Phillips Screws, we have made savings through faster assembly."

Emerson Radio and Phonograph Corp.

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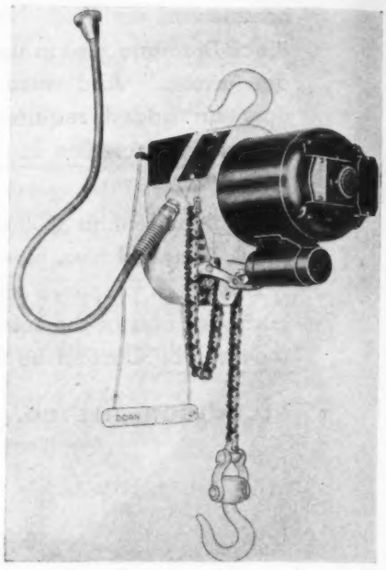
*WOOD SCREWS *MACHINE SCREWS *SHEET METAL SCREWS *STOVE BOLTS

U. S. Patents on Product and Methods Nos. 2,046,343; 2,046,837; 2,046,839; 2,046,840; 2,082,085; 2,084,078; 2,084,079; 2,090,538. Other Domestic and Foreign Patents Allowed and Pending.

small speaker-microphone from which the master station can be contacted by pressing a "call" button. Philco Corp., Tioga and C Sts., Philadelphia, Pa.

Reversible Motors

For use on cranes, hoists, lathes and many other industrial applications where instantaneous reversing is necessary, capacitor-start reversing motor is available in ratings of from ½ to ¾ horsepower, single phase, 60 cycles, operating at 1,725



r.p.m. on 115 and 230 volt circuits. Reversing the motor requires a special centrifugal-starting switch with two contacts, a solenoid relay, and a resistor, all of which are furnished as a part of the motor. A drum switch must be provided separately to operate the motor. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

"All-Purpose" Fluorescent Unit

"All-Purpose" fluorescent fixture, Model No. 2054, features the new duPont "Plastacele" diffusing shield, which hides the lamp bulbs entirely from view and furnishes a glareless, cool, and evenly distributed fluorescent light. Uses two 20-watt, 24 in. T-12 fluorescent bulbs. Mitchell Manufacturing Company, Chicago.

Heavy-Duty Integral Chain Vise Stand

Heavy-duty Vistand, with integral chain vise, yet light enough to be easily portable and well-balanced. Designed to prevent tipping or tilting, it has spreads of 50 in. in front and 43 in. from front to rear leg. Platform measures 14 in. in both width and depth and has notches and slots for tools around the rim. Equipped with three benders—one for ¾ in. pipe, and reverse benders for ½-in. and ¾-in. pipe—placed directly over the right front leg to guard against tipping during the bending operation. Additional features include the "dope" pot, cast

YOU DON'T *HAVE* TO USE ELECTRIC LIGHTS

and you CAN *"get by" cleaning your plant with brushes and brooms*

No company uses old fashioned oil lamps or candles, yet many "modern" companies still use old fashioned cleaning methods—they "clean" their plants with brushes and brooms instead of industrial vacuum cleaners.

Such companies pay at least a 500% cost-penalty by using hand cleaning instead of vacuum. For example, in one typical case, cleaning costs dropped from 30¢ to 4¢ per pound of dirt after Invincible Vacuum Cleaners replaced brushes and brooms.

Invincible vacuum cleaning is not only much *cheaper,* it is also much *better.* In the first place, Invincibles clean *every* part of the plant —not only floors and walls, but ceilings, beams, pipes, bins and machinery as well. And these light, easily-handled machines can be readily moved through congested areas. Secondly, they get *all* the dirt, unlike brooms which only get the larger particles and push the rest up into the air so that it resettles. For perfect cleaning there is *no* substitute for vacuum.

Possibly you are saying, "But our plant is different; vacuum cleaning wouldn't work for us." Overwhelming evidence, in the form of thousands of enthusiastic users in scores of industries, testifies to the contrary.

Thirty-five years' experience with industrial vacuum cleaning has proven to *us* that Invincibles can be profitably used in practically every industrial plant. Let our experienced engineers prove to *you* that Invincibles will keep *your* plant cleaner at less cost. Without any obligation they will study your problem and demonstrate the advantages of this modern cleaning method. Write Invincible Vacuum Cleaner Mfg. Co., 440 Davis Street, Dover, Ohio.

INVINCIBLE INDUSTRIAL VACUUM CLEANERS

MORE THAN 15,000 IN USE FOR OVER TEN YEARS

NEED ADDITIONAL PLANT FACILITIES for one of your ultra-active divisions?

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AS experienced building contractors in the industrial field, we can be of immediate service to you in the design, fabrication and erection of the units indicated in your building program.

From foundation to the last coat of paint, you'll find yourself relieved of unnecessary detail—free to give full attention to business—because P.DM's single contract and undivided responsibility for the complete job assures your satisfaction 100%.

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into the platform, round and big enough to hold a 1-lb. can of thread dope; adjustable ceiling brace screw; and feet punched for attaching to the floor, rubber "shoes" which prevent scratching or skidding on polished floors. Teeth of the vise are accurately spaced to hold each size of pipe, and each tooth is cut to prevent it from filling up with scale. Armstrong Mfg. Co., Bridgeport, Conn.

Inside-Silvered Lamps

Nalco inside-silvered carbon filament lamps have been especially developed for infra-red ray processes in drying, baking, heating, and dehydrating. The pure, polished silver in the base end of the lamp acts as a reflector to project the infra-red rays toward the surface being worked on. North American Electric Lamp Co., 1047 Tyler St., St. Louis.

Soldering Iron Set

Electric soldering iron production set comprises four devices—soldering iron, rheostat, blower, and supporting stand to hold the iron. Stand can be supplied to hold the iron at any height or angle. Blower carries away all smoke and flux fumes from the operator, and permits a close view while soldering on small assemblies. Exhaust of the blower may be piped to the outside air if desired. Vulcan Electric Co., 600 Broad Street, Lynn, Mass.

2,300-Volt Starters

Line of 2,300-volt 60-cycle general purpose starters especially designed for protection against short circuits and overloads has just been announced. Composed of an oil-immersed contactor with self-cleaning copper tips, wide metal bearings, and copper-braided shunts for long life, and fuses for short circuit protection, the control and bus structure is completely metal-inclosed for compactness, easy installation, and safety.

Four standard types of starters provide for full-voltage starting, reduced-voltage starting, and reversing of squirrel-cage motors and synchronous motors. Start-

"Peeps" of the First Armored Division, U. S. A., in action at Fort Knox, Ky.

The "Peeps" Are Coming!

● They roar over ground that would kill a cow-pony. They turn on a dime and leave nine cents change. They're fast—nimble—tough. They're the sensational new reconnaisance cars that the 1st Armored Division affectionately calls the "Peeps."

On every exposed inch of armor plate, motor or chassis, "Peeps" get a dull, sheenless coat of olive green to provide protection against the grinding grit, the dirt, sand and water encountered in grueling field service.

Fast-working, dependable DeVilbiss Spray Systems apply the finish not only to these active little cars, but to tanks, field kitchens, squad cars, gun carriages, trucks, —all types of rolling stock now being rushed into service. And these Systems are giving results that meet fully the exacting specifications laid down by the Army.

All defense materials being manufactured today, from blitz-buggies to bomb-sights, must be given some sort of protective finish. Factories engaged in their production require maintenance painting, as well. And on innumerable jobs like these, sturdy DeVilbiss Spray Systems provide a positive answer to the call for greater speed —better results— greater economy of labor and supplies.

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THE COMPLETE DEVILBISS LINE CONSISTS OF: Spray finishing equipment • Automatic coating machines • Tanks for spray materials • Spray booths and exhaust fans for vapor and dust elimination • Air regulators, cleaners and dusters • Air compressors • Respirators • Specialized hose for paint, air, water, gasoline, welding and pneumatic tools • Hose connections • Water and oil guns • Equipment to prevent offset in printing • Paint stripers • Medicinal atomizers • Perfume atomizers.

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There's AMPLE SUPPLY of Careyclad BLACK METAL COATING

IF priority listings or rationing have restricted your normal supply of metal coatings, CAREYCLAD may meet your requirements. CAREYCLAD does an effective job; it's economical; and the supply is plentiful.

CAREYCLAD protects metal against rust and weather — is extremely durable, abrasion resistant, and resistant to acid, alkaline and salt atmospheric conditions. It is a practical low-cost coating for metal buildings, iron sheets, structural steel, bridges, heavy machinery, ornamental iron work, and numerous sheet metal products.

Applied by spray painting, brushing, or dipping, at everyday indoor or outdoor temperatures. Promptly available in quantity through CAREY Branches and Distributors everywhere. Write for details, address Dept. 31.

THE PHILIP CAREY MANUFACTURING COMPANY • Lockland, Cincinnati, Ohio

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ers for special applications are also available. Starters afford protection against short circuits by use of current-limiting fuses, which limit short circuit current in less than ¼-cycle, and open in less than ½-cycle and have a disconnect feature that makes possible the isolation of an individual starter without causing the entire motor line to be shut down. Motors are protected against overloads by isothermic relays which operate in case of locked rotor, single-phasing, or sustained overload. Undervoltage protection is provided; on low voltage or loss of power, the line contactor opens and on return of power the motor will not restart until the pushbutton is operated. General Electric Co., Schenectady.

Pumps

The Pomona Pump Co., St. Louis, Mo., has recently been granted patents covering design improvements which eliminate hydraulic losses in pumps, thereby increasing efficiency as much as ten percent. These improvements, now included in all vertical turbine pumps, with fundamental design changes in the guide vanes, to alter, from horizontal to vertical, the flow direction of fluids being pumped. By forming advanced vane ends of a bulbous shape, regardless of the flow direction, fluid is substantially tangential to vane surface. Greater uniformity of flow pattern is secured, friction is reduced, and efficiency of fluid lift is increased. Because of the recessive curve at the rear of the bulb-shaped vane, eddy currents are not developed. The Pomona Pump Co., St. Louis, Mo.

Strap Holder

Where shipping department space is limited, "strap holder" may be used under a bench or packing table. Strapping feeds smoothly from the inside of the coil through the top coil guard. Holder is designed for use also as a portable reel. Equipped with casters. Detachable handle to facilitate movement of the strap holder by the operator can be provided. Strap holder without the handle is designated as Model 11, with the handle, Model 11-A. Signode Steel Strapping Co., 2600 N. Western Ave., Chicago.

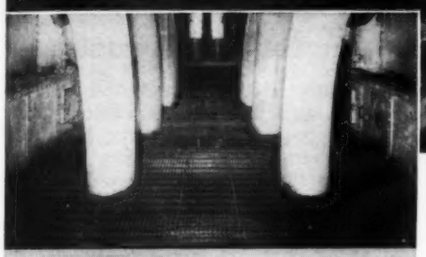
Surface Plate

Cast in semi-steel and finished plane within 0.005 in., large surface plate offers seven specific support-points for utmost flexibility in usefulness for machine shops, tool and die makers, and large toolrooms. Two sizes of adjustable blocks or legs (10 in. and 12 in.) provide possible working-surface heights between 29 and 33 in. Blocks support threaded 1½-in. screws, each topped with a circular cap that is recessed to contain any of the projecting support-points on the bottom of the plate. A 12-pitch thread provides fine adjustment to compensate for floor irregularities, etc. Five of these blocks are provided with each surface plate.

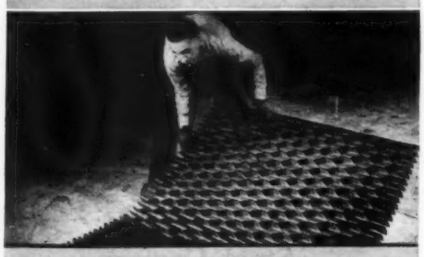
Ribbed underside of plate is designed

WALK AS SURE-FOOTED AS A CAT!

FACTS ABOUT OPEN STEEL GRATING



ECONOMICALLY INSTALLED. Every section of Open Steel Grating is built to the requirements of the individual job. This factory layout insures speedy installation and perfect fit.



LIGHT WEIGHT. Every pound of material is used, with maximum efficiency to carry or distribute loads—meaning less dead weight, lighter supports, reduced erection costs.

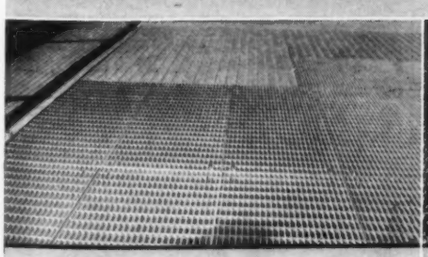
ALTHOUGH the surface of an Open Steel Grating Floor is even and regular, it also has a tendency to prevent slipping and sliding. This because its various members run at oblique or right angles to each other. And, because of its *open* construction, it does not accumulate dust, dirt, grease, oil or other skid-inducing substances.

Open Steel Floor Grating is factory-fabricated from a combination of structural steel members, simply and rigidly connected in a manner that makes it possible for them to carry and distribute a given load with an ample safety factor.

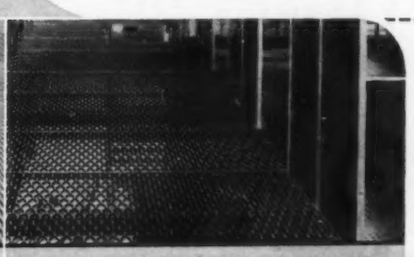
The non-slip surface of Open Steel Grating Floors does not *wear* smooth. It remains as long as the floor itself. For complete technical information on the many types of durable, fireproof, rigid Open Steel Grating Floors that are factory-fabricated to *your* individual requirements, write today for the free booklet, "New Ideas in Functional Floor Design."

This seal is your assurance OPEN STEEL FLOORING INSTITUTE *of a quality product*

OPEN STEEL FLOORING INSTITUTE, INC.



SELF-CLEANING. Open Steel Gratings do not accumulate dust, dirt, grease, oil or moisture. Their construction makes them virtually self-cleaning.



FREE CIRCULATION OF LIGHT AND AIR. Because of its construction, Open Steel Grating lets light through to spaces above and below—gives free ventilation and escape for fumes and gases.

OPEN STEEL FLOORING INSTITUTE, INC.
Dept. C-10, American Bank Building
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Send me, without obligation, your new booklet, "New Ideas in Functional Floor Design."

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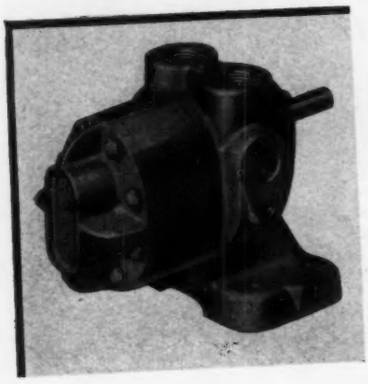
ROPER *Rotary* PUMPS

handle any liquid from A to Z



It makes no difference how thin, or how thick the liquid is that you have to pump, a Roper will handle your needs. Any liquid free from abrasives can be pumped with surprising economy and efficiency. Whether used for general transfer or for use on a hydraulic mechanism the new Roper will deliver a smooth, even flow.

HYDRAULICALLY BALANCED

Write for Catalog 938 with complete information.

Alcohol	Molasses
Asphalt	Naphtha
Bilgewater	Olive Oil
Boiler Compound	Paints
Catsup	Peanut Butter
Chocolate	Petroleum
Creosote Oil	Quenching Oils
Drugs	Road Oil
Dyes	Rubber Cement
Essential Oils	Shellac
Fruit Syrups	Soap
Fuel Oil	Syrups
Gasoline	Tarvia
Glue	Tomatoes
Hot Lard	Varnish
Ink	Water
Kerosene	Yeast
Lacquer	Zinc Nitrate
Lubricating Oils	

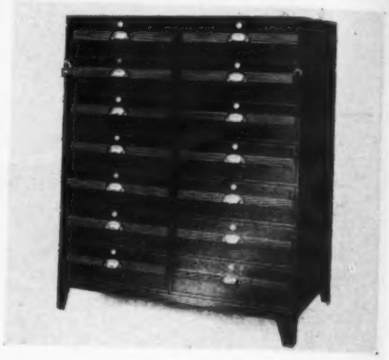
In fact, any liquid free from abrasives.

GEO. D. ROPER CORP., ROCKFORD, ILL.

to provide maximum strength without excessive weight. Surface plate weighs 3 tons. South Bend Tool & Die Co., 1916 S. Main St., South Bend, Ind.

Steel Drawer Cabinet

Cabinet of sturdy steel construction, provides individual drawers for employees to keep their tools and other equipment. Can be made with any number of drawers. Drawer sizes 20x20x6 inches. Can be supplied with cylinder locks or provisions for padlocks. Standard Pressed Steel Co., Philadelphia.



Roller-Arm Actuator

Combining the advantages of $\frac{3}{8}$-in. overtravel, large reduction in effective operating pressure, and construction suited to high-speed cam operation, Type Y actuator for Mu-Switches provides means of adapting these switches to a wide variety of applications. Actuator comprises a nickeled steel arm carrying at one end a graphite impregnated, self-lubricating bakelite roller and pivoted on an oilless bearing at the other end. A U spring of phosphor bronze, riveted to the underside of the arm, transmits actuating force to the operating button of the switch and absorbs excess movement at the roller.

The design of the attachment bracket permits actuator to be applied with equal facility to either side of the standard Type M (a.c.) and the heavy-duty Type D (d.c.) Mu-Switch. Mu-Switch Corp., Canton, Mass.

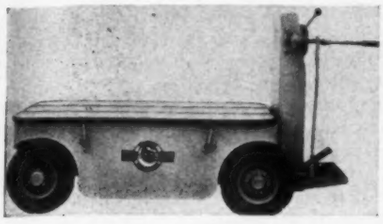
Steel Grating

Safety, rigidity, durability, self-cleaning, and sure-footed travel are features of one-piece welded steel grating designed for passageways and platforms, inside or outside or between buildings, for ramps, stair treads, covering for flow-ways. Made of hot rolled hexagonal steel bars placed at right angles on top of flat bearing bars set on edge, and then electro-welded under great pressure. The cross rods, sunk flush and welded into the bearing bars, make a rectangular mesh, that provides capacity for heavy loads. No holes nor cracks in the metal to gather oil, grease, or other refuse. Standard grating is made with the main bars on $1\frac{3}{16}$-in. centers, in panels 24 in. wide and lengths to 35 ft. Other spacings can be furnished. A "Safe-Load Table" is

furnished for bearing depths, and thicknesses to meet requirements. Wm. F. Klemp Co., 6611 South Melvina Ave., Chicago.

Truck for Interior Work

Features of truck known as K-39 include quiet electric motor operation, combined with demountable pneumatic tires.



Developed to meet the needs of organizations with interdepartmental transportation problems over floors not generally suitable for truck and tractor usage. K-39 is suitable for general utility work, and has a capacity of half a ton. Crescent Truck Co., Lebanon, Pa.

Fixture Hangers

The U Series fixture hanger Pylets, especially designed for installation of the combination mercury vapor and incandescent lamp fixtures, provide for permanent mounting of the transformer required for the mercury vapor lamp, above the messenger or span wire. Weight of the transformer is carried by the support rod attached to the ceiling structure of the building. With this method of installation, lighting fixtures only are below the messenger or support wire, and may be removed independently for maintenance attention. The union hub of the Type U Pylet is slotted to receive the messenger wire and a steel barrier is provided within the hub through which the messenger wire can slide without danger of abrasion to wiring. Space is provided for two pairs of No. 10 wire. The Pylet body will take a single- or two-gang receptacle providing for attachment plug connections to the mercury vapor and incandescent lamp circuits. Available in two sizes, with ¾- or 1-in. conduit hubs. The Pyle-National Co., 1334 North Kostner Ave., Chicago.

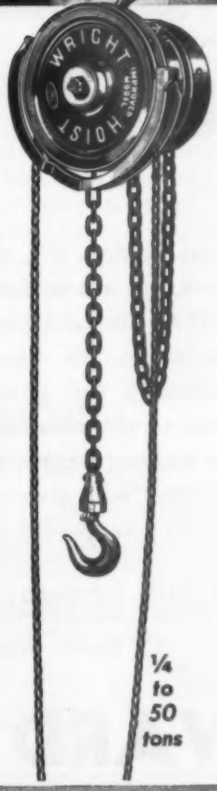
Continuous Row Fluorescent Lighting Units

Continuous row Miralume fluorescent lighting units designated F-104, F-208, and F-154, and F-308 may be joined end to end with like units or with one another to form a continuous wireway inclosure. Miralumes F-104, F-208, F-154 and F-308 are supplied with end caps for individual mounting. Miralumes F-104J, F-208J, F-154J and F-308J are supplied with a connecting band for continous row assembly. Thus, instead of providing a single electrical outlet for each unit, one outlet can be made to supply a row of units. Units are easily maintained. Reflectors are attached to the top housing; starters are located in the top housing. F-104 is a 100 watt unit, with two 40-watt T-12 Hygrade fluorescent lamps; over-all

★ WRIGHT *Improved High-Speed* HOISTS have been selected by thousands of industrial plants to aid them speed their defense work. It is gratifying to us that WRIGHT hoists are playing such a vital role in our national security program. We know, from the way they are built, WRIGHT hoists will continue to serve—so quietly, so efficiently they will be taken for granted and practically overlooked because only trouble commands attention—and WRIGHT hoists are famous for being trouble-free.

WRIGHT hoists and trolleys are engineered for *fast,* high-speed work with the maximum of safety. They are made by men who have studied and solved thousands of individual hoisting problems, then designed and built hoists to fit.

Let WRIGHT engineer your hoisting and crane problems. Work through the WRIGHT distributor in your city. You will find him listed in the classified telephone book.



¼ to 50 tons

WRIGHT MANUFACTURING DIVISION
YORK • PENNSYLVANIA
In Business for Your Safety

AMERICAN CHAIN & CABLE COMPANY, Inc.

should old

acquaintance

be-e forgot

Even under the pressure of National Defense work, we are making every effort to maintain our civilian contacts and to supply old friends whose patronage we have enjoyed through the years. Naturally the government comes first. Delivery dates to civilians are often long and uncertain. We are making a conscientious effort, however, to serve you and will give your inquiries the best attention within our means.

WARD LEONARD ELECTRIC COMPANY

55 South Street, Mount Vernon, N. Y.

WARD LEONARD

relays • resistors • rheostats

ELECTRIC CONTROL DEVICES SINCE 1892

length, 53 3/16 in., over-all width, 13¾ in., over-all height, 7¼ in., average weight, 32 lb. F-208 consists of two F-104 reflectors joined end to end on a single channel housing; over-all length, 106 1/16 in.; average weight, 64 lb. F-154 is a 150-watt unit, complete with three 40-watt T-12 fluorescent lamps; over-all length, 53 3/16 in.; over-all width, 13¾ in.; over-all height, 7¼ in.; average weight, 37 lbs. F-308 consists of two F-154 reflectors joined end to end on a single channel housing; over-all length, 106 9/16 in.; average weight, 73 lbs. All units equipped with Dua-Lamp high power factor auxiliaries and Mirastat starters. Operating voltages—units available for 110-125 volts, 60 cycle a.c. Can also be supplied in 50 cycle a.c. Hygrade Sylvania Corp., Ipswich, Mass.

Portable Industrial Engine

Three 2-cycle, portable, air-cooled industrial engines for chain saws, pumps, generator sets, fire-fighting equipment, compressors, have been announced. Features include easy starting, freedom from carbon and sparkplug trouble; cool running after many hours of continuous use. The line consists of a 1-cyl., 2½-hp. engine, a 2-cyl., 5-hp. engine, and a 4-cylinder model to develop 10 horsepower.

Motors can be used in either vertical or horizontal position, and are available complete with clutch, various gear ratios, and with swivel transmission. Kickhaefer Corp. Cedarburg, Wis.

Turbo-Vacuum Compressors

The 50-ton turbo-vacuum compressor recently added to the Trane Co. line, which already includes 70, 100, and 200 ton sizes, is constructed along the same lines as the other sizes and possesses the same characteristics. Is a hermetically sealed, low pressure water chiller constructed with two cylindrical steel shells. A single motor with all impellers on a single shaft is contained within the lower shell with the water chilling coil, while the upper shell houses the condenser coil. Approximate over-all dimensions of the 50-ton unit are, length, 140 in.; height, 73 in.; width, 44 in. Weighs approximately 9,300 lb. The Trane Company, La Crosse, Wis.

Steel Hoist

Known as the F-½, steel hoist is built in 1,000- and 2,000-lb. capacities, is a compact unit, designed to occupy a minimum of headroom space with maximum lift power. All gears and shafting are made of alloy steel with approximately 278,000 lb. per sq.in. of tensile strength. Main frame is of welded steel plate. Both 1,000- and 2,000-lb. capacities are powered by a high-torque hoist motor. Control is by pushbutton pendant with single or two speeds for polyphase alternating current. Provision is made also for use of 110-220 volt single-phase current. Load brake, incorporated in the hoisting gears, automatically controls speed when

LAN O KLEEN*

helps keep hands healthier . . . and *more productive*

* Some wash-fountain soaps are too mild to cut shop grime.
★ The potent ones are often dangerously caustic . . . irritate the skin.
★ The sand paper effect of grit-loaded hand cleaners does plenty of harm.
★ But all such hand and skin abuse is needless NOW . . .

NOT a liquid soap. *NOT* an abrasive paste . . . A GRANULAR, DRY PRODUCT used with a dispenser that automatically measures just the right amount, CONTAINS SPECIAL SOAP and EMOLLIENT LANOLIN OIL impregnated and sealed into granular CORN-MEAL base.

In use it removes the oiliest grime —printing ink for example—with SO MILD AN ACTION in doing it that you stand amazed at its efficiency. It is non-caustic. The corn-meal absorbs the dirt instead of grinding off a layer of skin.

MOST USEFUL OF ALL, the lanolin oil leaves a film on the skin of the nature of the natural skin oils. THAT'S WHY Lan-O-Kleen tends to do away with chapping, and dermatitis-causing irritation. COST? A little Lan-O-Kleen goes a long way, which makes it an economy product. See description folder.

*Trade-Mark Reg. U. S. Pat. Off.

★ **YOU JUST HAVE TO TRY IT AT YOUR OWN WASH BASIN TO KNOW THAT HERE IS SOMETHING WHICH WILL PAY TO PROVIDE IN YOUR PLANT**

WEST DISINFECTING COMPANY

PRINCIPAL PLANT AND OFFICES
42-16 West St., Long Island City, N.Y.

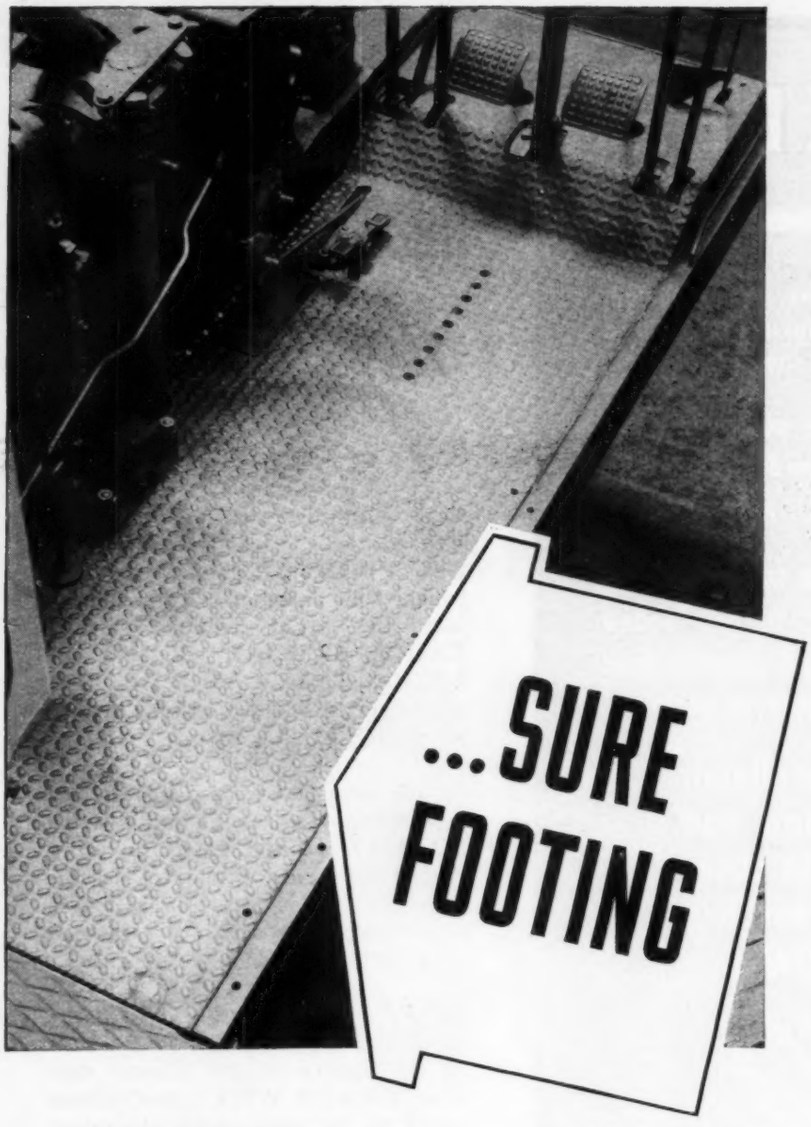
A coast-to-coast service organization with Branches and Offices in: Albany, Albuquerque, Baltimore, Birmingham, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Columbus, Dallas, Des Moines, Denver, Detroit, Evansville, Ft. Worth, Hartford, Houston, Indianapolis, Jacksonville, Jersey City, Kansas City, Los Angeles, Louisville, Memphis, Milwaukee, Newark, New Orleans, Norfolk, Oakland, Oklahoma City, Omaha, Philadelphia, Pittsburgh, Portland, Providence, Richmond, Rochester, Sacramento, St. Louis, St. Paul, San Antonio, San Francisco, Seattle, Spokane, Syracuse, Tacoma, Toledo, Tulsa, Washington, D.C., and in Canada.

A GUARANTEED PRODUCT

WEST DISINFECTING COMPANY
Dept. J, 42-16 West Street, Long Island City, N. Y.

FREE TRIAL NO STRINGS ATTACHED I am interested in experimenting with a free trial quantity of LAN-O-KLEEN and the loan of a dispenser in which to use it.

Name _____ Title _____
Company _____
Street & No. _____ City & State _____



U·S·S MULTIGRIP Floor Plate was designed to withstand hard usage and to provide maximum safety underfoot. Wherever men walk or work, where a slip or a fall might result in a serious accident, that's where you can put U·S·S Multigrip Floor Plate to work for you.

Multigrip's scientifically designed risers are all at right angles to one another, giving a maximum of non-slip floor surface with traction for workmen's feet in every direction. An added safety factor — Multigrip is easy to clean because there are no corners to catch and hold dirt or refuse. Write to us for more information regarding the use of U·S·S Multigrip Floor Plate for factory flooring or for use on equipment.

U·S·S MULTIGRIP FLOOR PLATE

CARNEGIE-ILLINOIS STEEL CORPORATION
Pittsburgh and Chicago
Tennessee Coal, Iron & Railroad Company, *Southern Representatives*
Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Export Company, New York

UNITED STATES STEEL

the load is lowered. If power fails, it prevents the load from dropping. Hoist drum is fabricated from steel pipe and steel flanges, and is jig-welded and machined. Entire lift of the hoist is provided without overwind of the cable.

F-½ steel hoist can be applied to any make of monorail. Motor-driven trolleys with speeds of 60 to 100 ft. per min. at single speed and with pushbutton can be provided. Robbins & Meyers, Inc., Springfield, Ohio.

Water Control for Multiple Boilers

System of multiple boiler water control, which maintains safe and proper water levels in two or more boilers with one boiler feed pump, has been announced. Each boiler water level is controlled separately, and water added independently of the other boilers. Electrically controlled, completely automatic in operation.

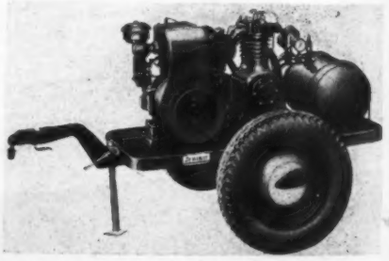
Two stationary electrodes, of different lengths, are mounted in a small holder on each boiler. When water level in any boiler falls below the longer electrode, an electric circuit is disturbed which, through a relay, starts the boiler feed pump. A motor-operated valve is opened to divert the pump discharge into the boiler requiring water. When water level reaches the desired level the pump stops. Suitable for pressures up to 150 lb., for all boilers up to 250 hp. Can be used with any type of steam or motor-driven boiler feed pump. It can also be arranged with a duplicate "stand by," or emergency, pumping unit. Johnson Corp., Three Rivers, Mich.

Box Wrench Set

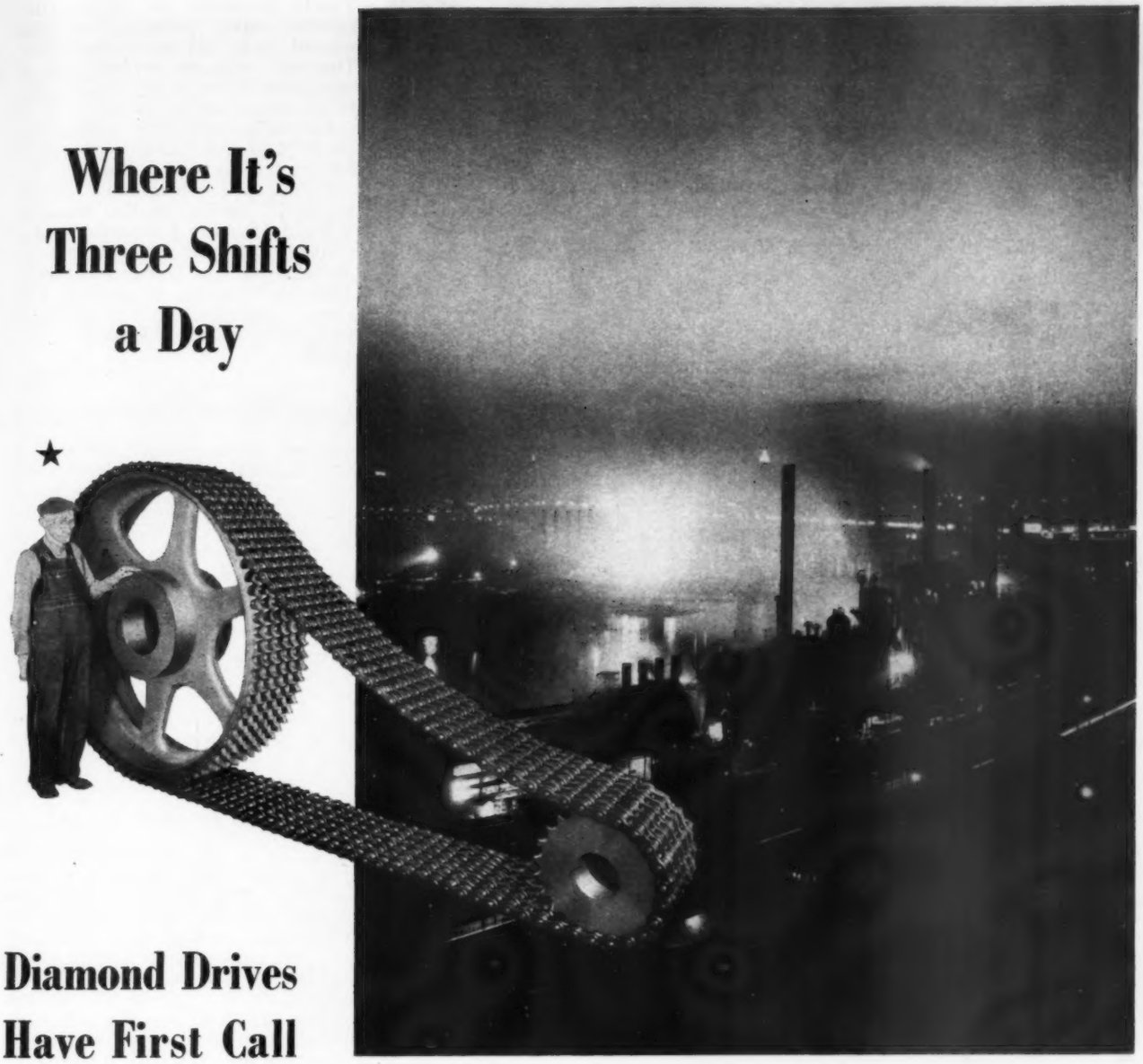
Known as No. 36, a set of box wrenches with double hexagon openings and heads placed at 15 deg. angles contains two short and four long wrenches, each with a different size opening in each end. Especially adapted to all production and service work. Either side of the head may be applied to the nut or bolt. Furnished in a leatherette roll with an individual pocket for each wrench. Bonney Forge & Tool Works, Allentown, Pa.

Spray Paint Air Compressors

Four- and 6-hp. portable spray-painting air-compressing outfits, for operating two and three spray guns, for larger installations in industrial and maintenance work.



Where It's Three Shifts a Day



Diamond Drives Have First Call

• In the steel mills of the U. S. A., output is keyed to new tempos daily—and in this industry, too, Diamond Roller Chain Drives are shouldering an ever-increasing responsibility.

They are used for countless purposes such as the driving of slitters, side trimmers and end shears; roll grinders and polishers, cleaning machine rolls, continuous strip cyaniding and annealing furnace rolls, upcoilers, coil rewinders and decoilers, continuous picklers and galvanizers, spiral and seamless pipe machinery, projectile mills, wire weaving machines, 96" continuous plate mill between stand chutes; feeder, run-out and catcher table conveyors.

Born of the steel industry—fashioned into a power transmission of roller-bearing efficiency—Diamond Roller Chains are extremely rugged yet as precisely made as a fine watch. They transmit power smoothly and dependably, with practically no power wastage. They don't slip or creep—they can be counted on for the long hours of gruelling operation, three shifts a day with speed ratios held always to 100%.

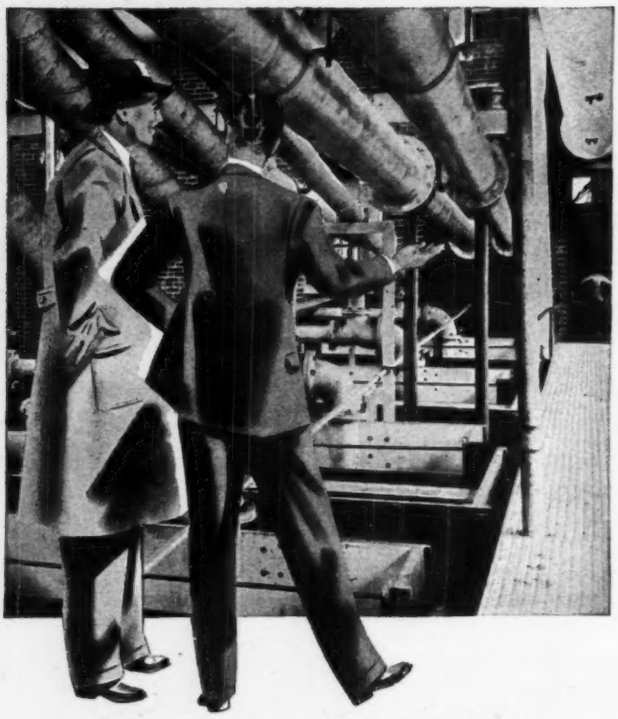
While Diamond Chains are performing important functions in the steel industry—they are widely used in every industry—on machines of every kind, large and small;—for motor drives of fractional or a thousand horsepower; for slow motions and for speeds up to 4000 r.p.m. Experienced production men and engineers have found that it pays to insist on DIAMOND Roller Chains for their mechanical power-transmitting jobs. ....DIAMOND CHAIN & MFG. CO., 449 Kentucky Avenue, Indianapolis, Indiana. Offices and Distributors in All Principal Cities.

DIAMOND ROLLER CHAINS

★ *Six strand width Diamond Roller Chain Drive from 550 H. P. motor to sheet mill.*

Piping Troubles?

We Don't Have 'Em Any More!



"Nowadays, we put our pipe problems up to ARMCO. *They design our lines with 'Spiral Welded' and save us both time and money."*

He's right! Piping troubles vanish when you run your lines with ARMCO Spiral Welded. Every foot is carefully "tailored" to fit your job. Even the most complicated installations go in easily and economically.

Besides saving hours of tedious assembly, ARMCO's method of pre-fabricating pipe cuts material costs to the bone. With standard or special fittings welded to straight pipe runs, you eliminate at least one pair of flanges at every bend. Savings up to 25 or 30% on the cost of a single job are not unusual. And maintenance is bound to be small; fewer flanges mean less chance for costly leaks.

There is a size and gage of ARMCO Spiral Welded Pipe to meet every piping requirement. Diameters range from 6 to 36 inches, wall thicknesses from 7/64 to ½-inch, with optional coatings and linings. Just send us a dimensioned plan of that next job. We'll gladly submit an accurate estimate and a sketch of our proposed design. The American Rolling Mill Co., Pipe Sales Div., 371 Curtis St., Middletown, O.

ARMCO

SPIRAL WELDED PIPE

Twenty assemblies are included—skid-mounted outfits, rubber-tired and steel wheeled trucks, and two-wheeled trailers. The 6-hp. units are available with or without an electric starter. Air or water-cooled engines are optional.

Twin disk clutch, which permits starting of the engine independently of the compressor, is standard equipment.

Spray-painting equipment for use with the outfits can be obtained separately. Two-gun equipment is designated as type QM-6016. It may be used with any of the 4- or 6-hp. compressing outfits. Three-gun equipment for use with 6-hp. units, is designated as type QM-6017. DeVilbiss Company, 300 Phillips Ave., Toledo.

High Temperature Packing

Asbestos packing for elevated temperatures has been added to the Palmetto line of packings. This packing, known at Palmetto Cab Cock packing, is braided from long-fiber Canadian asbestos yarn. Each strand is individually coated with dry graphite to retard fusion of asbestos and to provide an antifriction wearing surface. Contains no liquid lubricant that might be boiled away. Intended for pumps and valves handling high-temperature steam, oils, and gases, and also for expansion joints, furnace door grooves, locomotive cab cocks. Greene, Tweed & Co., Bronx Blvd. at 238th St., New York.

Vacuum Machines

Portable vacuum cleaner, No. 25 Hushed Hild, operates with a minimum of noise. Attachments are available for blowing dirt from motors, cleaning overhead beams, removing floating dust, cleaning walls, pipes, bins and venetian blinds, as well as scrubbing floors. Over-all height, 24 in. Weighs 76 lb. with electric cable, hose, floor tool, and handle. Equipped with 3-in. rubber casters. Hild Floor Machine Co., 1313 Randolph St., Chicago.

Impact Wrenches

Lightweight, air-operated impact wrenches. Sizes 504 and 508 are reversible and designed with the patented Pott impact wrench principle which localizes the steel to steel impact without transmissing shock to other parts of the tool, form-fitting pistol grip handle, short over-all length, and small nose diameter permits their operation in close places. Five sizes, for applying and removing nuts from ¼ to 1¼ inch bolt size are available. Ingersoll-Rand Company, 11 Broadway, New York.

Soldering Iron Stand

Automatic electric soldering iron stand can be set to maintain an iron in the device at a predetermined temperature, and have it ready for immediate use with bright tin on the tip. Desired idle temperature is obtained by an adjusting screw on the bottom of the stand.

HELPFUL HINTS ON CHOOSING VALVES FOR BETTER PIPING SERVICE
PLEASE CHECK AND PASS ON
POST ON SHOP BULLETIN BOARD
AN AID TO DEFENSE

Shop Bulletin No. 1 gives hints on handling valves and fittings; No. 2 shows pointers on piping placement. Ask your Crane Representative to explain how you can get valuable aid from this practical service.

Ready for you...

CRANE SHOP BULLETIN NO. 3

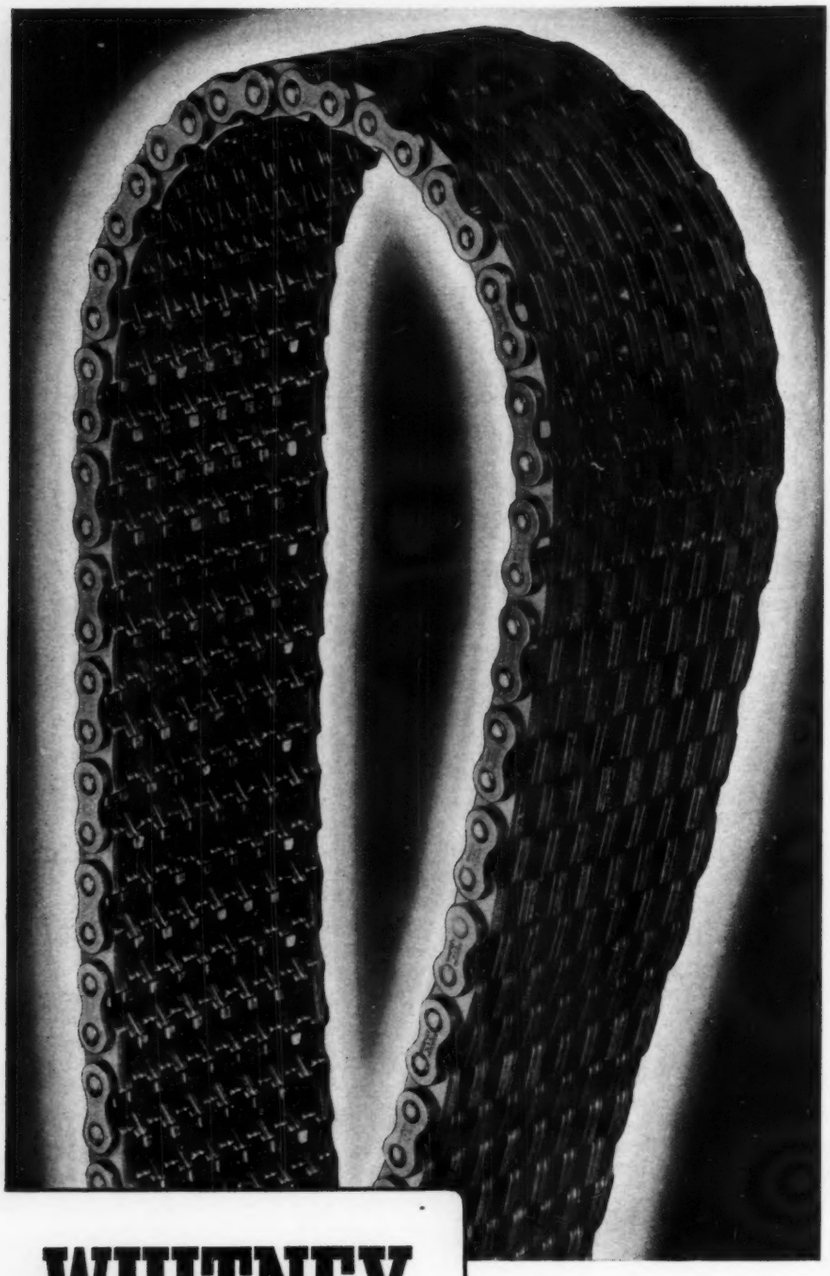
It's ready—to help you keep pipe lines in peak condition for peak production—to help you get maximum service from present equipment. This timely Crane Shop Bulletin Service is designed to aid you in training new maintenance men; and to caution experienced workers on piping fundamentals often overlooked with costly results. Bulletin No. 3 gives many valuable hints on the proper selection and usage of valves. Copies for distribution to your piping crews may be had from your Crane Representative—or by writing to us.

CRANE

CRANE CO., GENERAL OFFICES:
836 S. MICHIGAN AVE., CHICAGO

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS



WHITNEY CHAINS

give

TOP SERVICE
In Power-Delivery
...and in
full machine-production

Whitney Chains "keep 'em flying" on defense production lines . delivering full power to the job on 24-hour-a-day schedules . preventing machine slowdowns and shutdowns . and keeping chain costs down to lowest levels per drive unit. This extra stamina has caused Whitney Chains to be drafted in great numbers for defense equipment, as well as general industrial requirements.

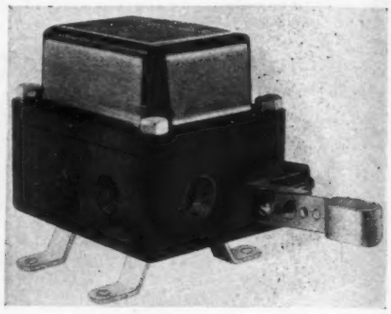
Whitney Chain & Mfg. Co.
Hartford, Connecticut

WHITNEY PRODUCTS . . . Roller Chain & Sprockets, Silent Chain & Sprockets, Conveyor Chain & Sprockets, Roller Chain Flexible Couplings, Automatic Load Limiting Sprockets, Automatic Drive Tensioners, Woodruff Type Machine Keys and Cutters.

A protective cage surrounds the iron, when in the stand, preventing burns and fire hazards. Bottom has rubber feet to eliminate sliding and marring of highly polished surface. A 6-ft. cord with a series plug is provided. Vulcan Electric Co., 600 Broad St., Lynn, Mass.

Float Switches

Type 9048AW watertight switch has inclosure of heavy cast-iron cover and base. A rubber gasket makes it watertight. Explosion-resisting float switch is identical to the 9048AW, except the surfaces between the cast-iron cover and base are machined to comply with Class 1



Group D hazardous location requirements. Entries to the switch chamber are through approved openings of closely fitted steel shafts. 110 to 550 volt a.c. or d.c. Square D Co., 6060 Rivard St., Detroit.

Automatic Temperature Indicator

Where a large number of thermocouple temperature readings are to be taken, automatic temperature indicator does the job in minimum time and requires minimum skill on the part of the operator. As many as 50 couples can be used with one instrument. All are individually connected to toggle-switches on the indicator front. To read a couple's temperature, the operator simply throws its switch, and a pointer moves automatically to the correct scale position. No dials to turn or galvanometer to watch, leaving the operator's hand free to make notations. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia.

Arc Welder Control Box

Welder control box of new design enhances the benefits of dual continuous control, prevents accidental contact with live parts, increases accessibility, permits wiring with flexible or rigid conduit, or rubber-covered multiple-conductor cable, and eliminates dangers from unintentional loosening of the lifting hook.

Features of the box, known as Type G, are the separate compartments for all a.c. circuits, including pushbutton, and for d.c. terminals. Both compartments have a snap catch that holds the door closed.

Special non-shorting lugs, which lock themselves in proper position before they can be bolted to the input terminals of the starter, prevent the possibility of

Simple PALLETS

Two wooden floors separated by 2 x 2's make a pallet any fork truck can pick up readily. This simple invention will save industry millions of dollars in handling and rehandling costs during 1941.

...earn millions of dollars!

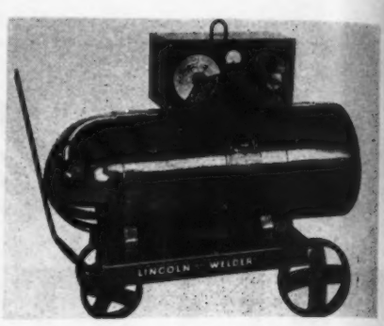
Handling and rehandling materials is one of the costliest items in manufacture. But costs decline wherever modern material-handling methods are introduced. The modern fork truck powered by a modern industrial battery keeps materials on the move within plants—makes loading and unloading freight cars cheaper—permits use of storage space from floor to ceiling. But the ***method alone*** isn't enough . . . it calls for a power source in the truck that gives quiet, smooth, trouble-free ***dependable*** operation.

That's why, probably, the Edison Alkaline Storage Battery powers more of the battery industrial trucks in the United States than all other kinds of batteries combined. With ***steel*** cell construction and a solution that is a natural preservative of steel, it is the lightest, most durable, most trouble-free of all storage batteries. Has two to five times longer life—assures lowest annual operating cost.

For more detailed information send for our bulletin ***Modern Material Handling.*** New edition, just off the press, describes the various industrial-truck handling systems; illustrates the latest methods; gives detailed data on alkaline batteries. Edison Storage Battery Division of Thomas A. Edison, Inc., West Orange, New Jersey, U. S. A.

Edison
STEEL *Alkaline* BATTERIES

INLAND 4-WAY
FLOOR PLATE
for safety on machines and floors
INLAND STEEL CO.
38 South Dearborn Street • Chicago
Sales Offices:
Milwaukee • Detroit • St. Paul • St. Louis • Kansas City • Cincinnati • New York



blowing up the input lines due to shorted input lugs because of careless maintenance.

The control box is permanently grounded to the motor and generator frames through the mounting bolts, making it possible to ground both the control box and the machine by simply grounding the conduit which leads to the box. The Lincoln Electric Co., 12818 Coit Rd., Cleveland.

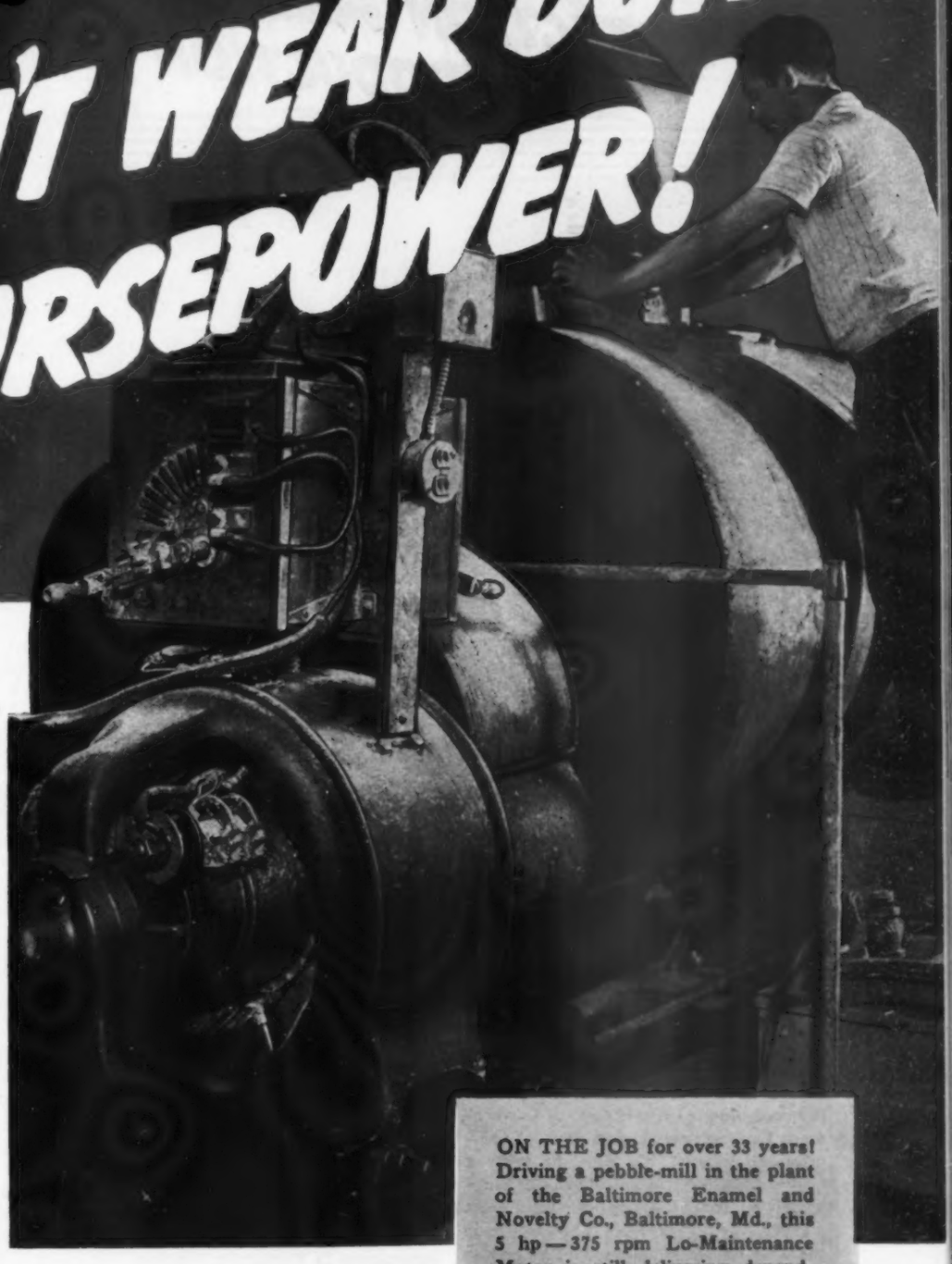
Insulators

Three Vibro-Insulators, the devices of rubber and metal that decrease vibration and noise in machinery of many types are listed as Types 14, 33 and 36. Type 14 is recommended for a load in vertical shear of 80 lb. per sq. in. deflection in shear of 1 inch at a loading of 80 lb., and minimum disturbing frequency at this deflection 470 per minute. This type also is supplied with the rubber in compression, by placing the metals in a horizontal position. The maximum recommended load under compression is 250 pounds per inch, deflection at that loading of 5/16 in. and the minimum disturbing frequency at that deflection 850 per minute. In Type 33 the rubber is applied only in compression, with the maximum loading 150 pounds and deflection at that point 5/32 inch, with the minimum disturbing frequency at that deflection 1,200 per minute. Type 36 is for work with the rubber in compression, although it can also be applied in shear. With 35 and 50 durometer hardness, loading beyond 20 per cent of the rubber thickness, or .175 inch is not recommended. Under this load the minimum disturbing frequency is 1,250 per minute and the load necessary to deflect 35 durometer mounting is 100 pounds, and for 50 durometer mounting 85 pounds. These are maximum load limits with lower loads recommended where possible, especially where disturbing frequencies are greater than 1,250. The B. F. Goodrich Co., Akron, Ohio.

Tube Fittings

Tube fittings with high pressure capacity rating, flexibility for rigid tube of up to 10 deg. included angle, yet which climinate necessity for special flexible tubing, reduce sound transmission in lines, and permit rapid assembly without special tools for the lower capacity uses. Fittings, known as Sealflex, handle high pressures while permitting vibratory flexing up to 10 deg. included angle. Made in a wide range of standard sizes, and

33 YEARS COULDN'T WEAR DOWN THIS HORSEPOWER!



ON THE JOB for over 33 years! Driving a pebble-mill in the plant of the Baltimore Enamel and Novelty Co., Baltimore, Md., this 5 hp — 375 rpm Lo-Maintenance Motor is still delivering dependable, trouble-free service.

Another Outstanding Case-History of the Dependable, Low Cost Performance of Allis-Chalmers Lo-Maintenance Motors. See How They Can Solve Your Power Problems Too . . .

SINCE 1908—for over 33 long years—this 5 hp — 375 rpm Allis-Chalmers Motor has been harnessed to a pebble-mill in the plant of the Baltimore Enamel and Novelty Co.

Day in and day out, water and abrasive enamel frit have worked to wear it down. But this motor is still on the job, in excellent condition, delivering uninterrupted, full-duty horsepower!

The value of quality construction and dependable operation is even more vital today. And when you buy Lo-Maintenance Motors, Allis-Chalmers engineering sees that you are getting *"more motor" for your money.*

Outstanding economy and operation are designed and built into Lo-Maintenance Motors. Their full-measure performance — more than just a rated horsepower — is based on such important features as indestructible rotor, distortionless stator, high carbon steel frame. *No stint or skimp in materials or workmanship means quality to the core.*

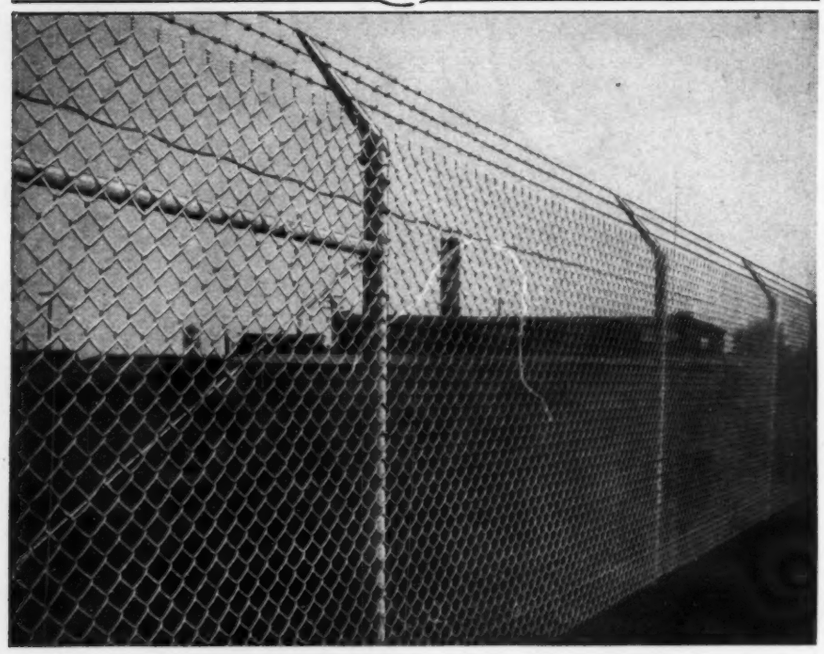
When you want motor performance like this in your plant, call the engineer in the district office near you. Or write Allis-Chalmers, Milwaukee, Wisconsin.

A-1438

ALLIS-CHALMERS LO-MAINTENANCE MOTORS

A COMPLETE LINE FOR EVERY PURPOSE...ONE-HALF HORSEPOWER AND UP

On Defense Contracts "PROTECTION" means "PRODUCTION"



Anchor Fence Protects Against Spies, Saboteurs

Safeguards Your Plant Production

In times like these, when "PROTECTION" means "PRODUCTION" of Government Defense work, it's time to give more than just a casual thought to your Fencing. It's time to provide absolute protection against the subversive interests intent on sabotage of Government Contract work and theft of Government secrets. It's time to erect a strong, rugged "Wall of Steel" completely encircling your plant. Then erect similar "Walls of Steel" around your plant's vulnerable points, such as power plants, transformer stations, chemical and fuel storage to make certain that *only your most trusted* and thoroughly investigated employees have access to these danger points.

SEND FOR THE ANCHOR ENGINEER. He'll show you how an Anchor Fence installation can provide protection against sabotage from *inside* and *outside* your plant, with a minimum expense for guards and policing. He'll show you how an Anchor Fence can be quickly installed, yet can be moved and re-erected in case of plant expansion. He'll give you the benefits of Anchor's long experience in Protective Fencing.

Write now for the Anchor Fence Engineer in your locality. He'll gladly help you plan complete protection. Anchor Post Fence Co., 6620 Eastern Avenue, Baltimore, Maryland.

NATION-WIDE SALES & ERECTING SERVICE

YOUR BEST DEFENSE IS AN ANCHOR FENCE

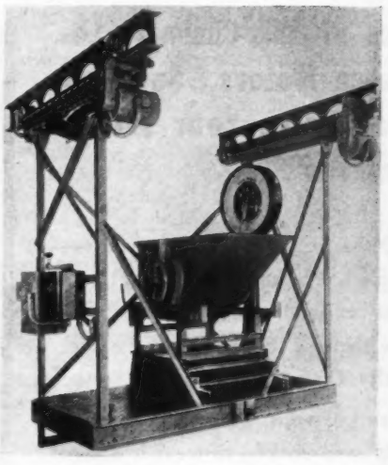
available for handling almost any fluid. Can be used for air, gas, gasoline, refrigerant. Supplied with standard pipe threads. Harris Products Co., 5419 Commonwealth Ave., Detroit.

Non-Automatic Enclosed Circuit Interrupter

High interrupting capacity and reduced mounting space are featured in the new non-automatic enclosed "De-ion" circuit interrupter known as the NEMA Type 1A. Two- or three-pole interrupters have 50- to 600-amp. ratings on 250 to 600 volts a.c. and 125/250 and 250 volts d.c. lines. Rust and corrosion resisting metals in all units; all main contacts of non-welding silver or special silver composition. De-ion arc quenchers are used to reduce contact burning and preserve the contacts. Safety features include a cover interlock which prevents closing of contacts when cover is open, and opening of cover when interrupter is in the "ON" position. Westinghouse Elec. & Mfg. Co., East Pittsburgh.

Batch Scale Car

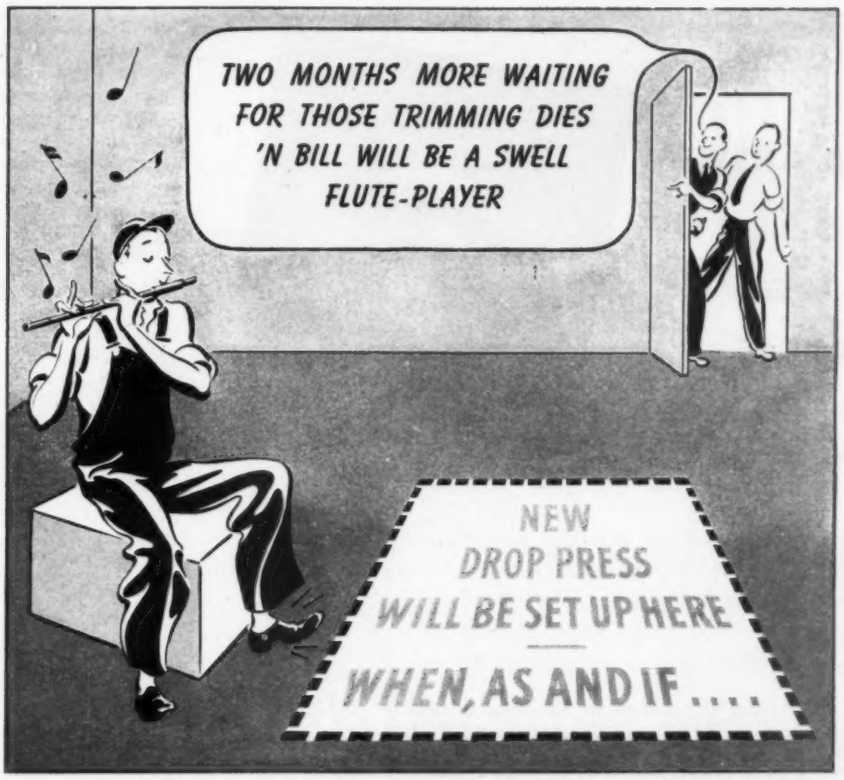
Traveling batch scale car can be adapted to the handling of chemicals and batch materials in a variety of industries. Car is motor-driven and controlled by an operator who rides on the platform space provided to the left of the bucket. Variable speed drum



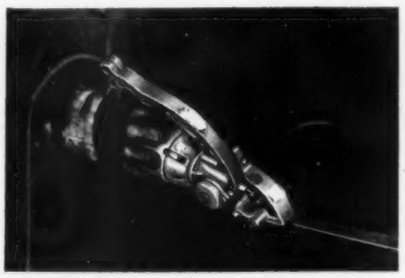
controller permits the car to be operated at any speed up to 300 ft. per minute. Double overhead rails make it possible to straddle overhead bins so that their chutes may be brought close to the car bucket. The unit makes it possible to gather the exact amounts from various bins that go to make up a batch. Scale on car accurately weighs the ingredients as they are dumped in. Bucket is easily emptied by tilting by a crank wheel. The Cleveland Tramrail Division, The Cleveland Crane & Engineering Co., Wickliffe, Ohio.

Fingerless Gloves

Fingerless glove meets the unusual requirements of operators who must have complete freedom of the fingers or


TWO MONTHS MORE WAITING FOR THOSE TRIMMING DIES 'N BILL WILL BE A SWELL FLUTE-PLAYER
NEW DROP PRESS WILL BE SET UP HERE
WHEN, AS AND IF . . . .

Is "Waiting For Big Machines" Stifling Your Production?



CUT UP TO 18 GAUGE hot rolled steel with "Mighty Midget". Easy to handle as a pair of snips. Eliminate costly and hard-to-get trimming dies and patterns with Stanley Unishears.

UP TO 12 GAUGE with this big capacity No. 144A Portable. Large sheets can be cut and trimmed, turned up edges cut off close to the surface. Carrying the tool to the work saves time and expense.

MANY of the trimming and sheet metal cutting jobs now done with expensive dies can be worked through your plant accurately and quickly with Stanley Unishears. 8 models – both portable and stationary types – give you capacity range from 18 up to 10 U. S. gauge hot rolled steel, as fast as you feed.

There are many other cost-cutting Stanley Electric Tools: Toolroom, Contour, Bench and Heavy Portable Grinders; Electric Hammers, Drills, Screw Drivers and Saws. Don't just "wait" for big machines; ask your Stanley distributor for a demonstration of how these tools can boost production, right now, or write for literature. Stanley Elec. Tool Div., The Stanley Works, 149 Elm Street, New Britain, Conn.

STANLEY
Electric Tools
A Complete Line for Industry

UP TO 16 GAUGE steel with No. 16A shown above. Cuts straight lines, curves, angles, notches. Feeds up to 15′ a minute. All Stanley Unishears are 100% safe.

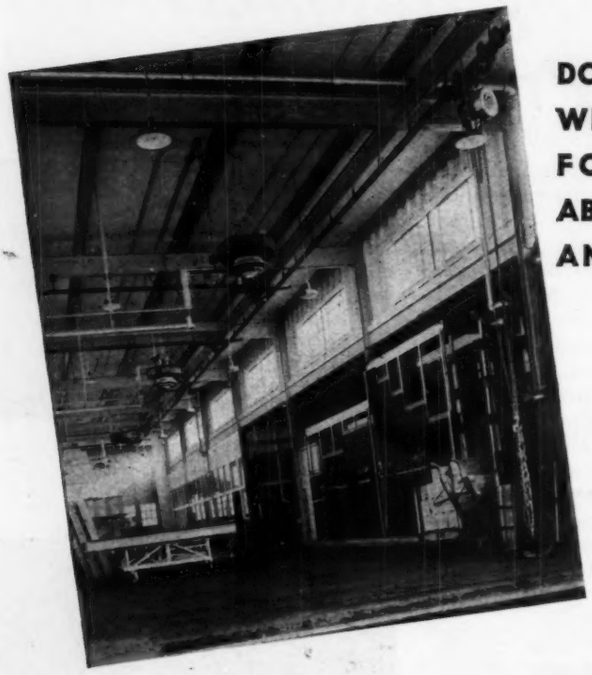
STANLEY UNISHEAR No. 0-54. Cuts inside holes or shapes without "starting holes"; cuts curves to less than ¼" radius. Its 54" throat handles sheets up to 9 feet in diameter. Two other "0" models–depth of throat: 15" and 36".

HERE'S THE ANSWER TO THE PROBLEM OF HEATING LARGE FACTORY AREAS . . .

ANEMOSTAT Draftless Air Diffusers in combination with vertical discharge unit heaters have solved the problem of heating large factory areas.

Users marvel at the way these scientific air diffusers establish and maintain an even, comfortable temperature at the working level throughout the areas they serve with no noticeable movement of air anywhere. Even in shop bays and other points where ceilings are low, operators working directly under the units are entirely comfortable.

By providing conditions conducive to health and comfort, ANEMOSTATS with unit heaters are production boosters. And every factory can secure the benefits they bring, not only in future heating seasons but also for the rest of the present season because ANEMOSTATS with unit heaters can be installed in a few hours.



Typical of the fast-growing use of ANEMOSTATS *with vertical discharge unit heaters is this installation in the Washington, D. C. warehouse of the Pittsburgh Plate Glass Co.*

DON'T DELAY— WRITE TODAY FOR DETAILS ABOUT TYPE HU ANEMOSTATS.

ANEMOSTAT
DRAFTLESS AIR DIFFUSERS
have won acceptance as an essential part of air conditioning, forced air heating and ventilating systems because they assure ideal air distribution. They're made in types and sizes for handling any volume of air at any velocity. Descriptive literature mailed on request.

ANEMOSTAT
CORPORATION OF AMERICA
Dept. F, 10 East 39th Street,
New York, N. Y.
Representatives in Principal Cities

"touch" to sort or pick up thin sheets or small parts. Protection is provided for the palm of the hand and between thumb and forefinger. Made of chrome-tanned long-wearing split leathers, glove is steel stitched to eliminate ripping. May be worn over the bare hand or pulled over lightweight glove. Three sizes: small for women, medium, and large for men. Industrial Glove Co., Danville, Ill.

Electronic Level Control

Photoswitch level control, Series P16, provides on-and-off valve or pump control of any liquid. Available for single-level indication and control, on-and-off pump-up and pump-down control at two levels, boiler feedwater control, and low-level safeguards. Probe fittings designed for high and low pressure and temperature requirements, as well as for sanitary installations. Photoswitch Inc., 21 Chestnut St., Cambridge, Mass.

Rubber-Base Steel Paint

Rubber-base paint brushes well and dries fast, is unaffected by water, and resistant to chemicals such as lime, acids, fumes of various kinds. Paratex metal coating is adapted to all kinds of exposed iron and steel. Protects aluminum, copper, and galvanized metal as well as iron and steel. Features durability and resistance to rusting and corrosion. The Truscon Laboratories, Caniff & G.T.R.R., Detroit, Mich.

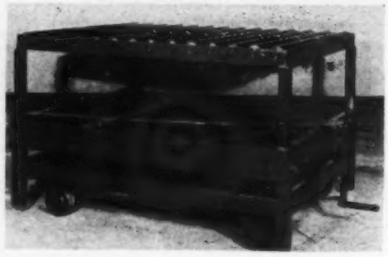
Welding Trailer

Four-wheeled, lightweight, pneumatic-tired trailer for mounting Hobart electric drive welders is announced. Useful for making hurry-up trips to different parts of the plant and yard for emergency production, maintenance, and repair work. Mounting is easily accomplished by four bolts in the frame of the trailer which register with four holes in the legs of the welding machine. Unit is easily moved by hand.

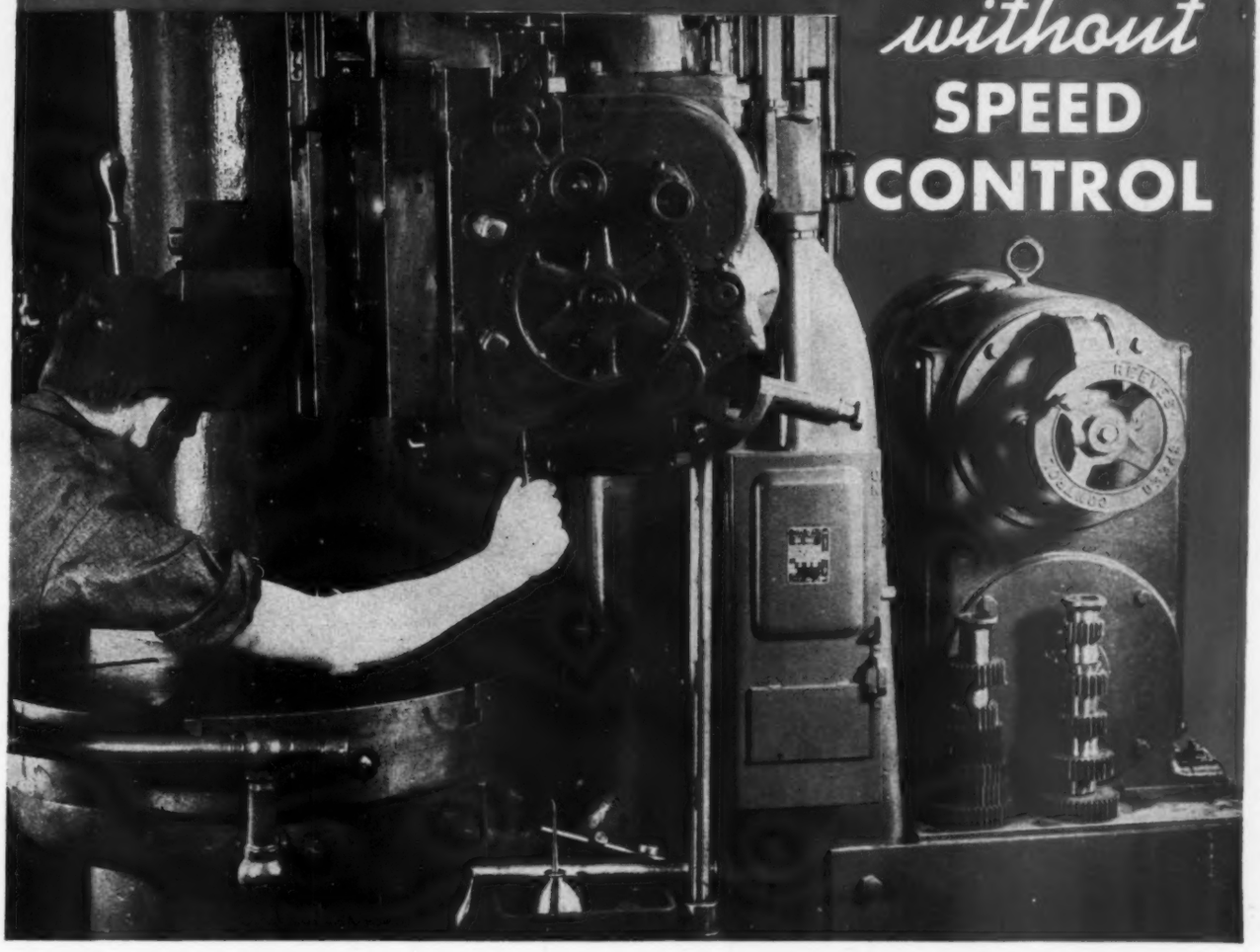
Weighs 120 lb.; measures 12⅞ in. high; 45 in. over-all height; 44 in. over-all width; 33 in. from hub to hub; 25 percent tilting angle; 14 in. jumbo four ply tires. Hobart Brothers, Troy, Ohio.

Lift Table

Liftable, with 5,000-lb. capacity can be used as a feeding table for press work. Load is held at working level, material need not be transferred from one truck to another. Construction is



IMAGINE DEFENSE PRODUCTION *without* SPEED CONTROL



Never, in the same length of time, could American industry have turned out the thousands of machines of defense, now rolling off production lines, if we were still dependent upon antiquated lineshaft power transmission methods, step-cone pulleys and *fixed machine speeds.* Maximum *acceptable* production with fewest "rejects" comes only when machines are operated at exactly the right speeds—*not too fast, not too slow.*

But increased volume was not the only objective gained by the adoption of individual motorization of machine tools, and *infinitely variable speed control.* Higher quality of output, largely the result of accurate speed adjustability, has made American machines and manufactured products the envy of the entire world.

This company is proud of the part it has played in *pioneering, developing and perfecting variable speed control* units which are accepted throughout American industry as standards of comparison. Our plant is working at high pitch to meet the demands intensified by the present emergency for these units. If you have a machine, or a line of machines which make an essential contribution to our domestic or defense economy, and which can be made more productive with variable speed control, we will equip them for you.

REEVES PULLEY COMPANY, *Dept. F,* **COLUMBUS, INDIANA**

REEVES *Accurate Variable* SPEED CONTROL

American Soldiers get the best of care . . How about your workers' hands?

The defense of democracy depends equally on soldiers and industry. Industry relies on workers' hands for production and precision. Formula SBS-11, the safe industrial skin cleanser removes dirt, grease, and grime quickly and easily; helps prevent sore, irritated, or infected hands.

Formula SBS-11 costs less than 1c a week per worker. Used today by 5657 leading manufacturers. Write today for generous free trial supply to Sugar Beet Products Co., 303 Waller Street, Saginaw, Michigan.

Formula SBS-II

THE WASHWORD OF INDUSTRY

of steel, electric welded throughout. Table is raised and lowered by a vise-type handle. Lifting mechanism consists of a steel screw that actuates the lifting chains. Safe to operate, table is locked at working height by a cam lock. Size 4 ft. wide by 5 ft. long. Top is a double row of rollers measuring 2½ in. in diameter and running on sealed anti-friction bearings. Height of table when extended is 36 inches; when lowered 24 inches. All wheels are of floor protective material. Casters are pressure lubricated throughout. Standard 2,000-lb. capacity model also available, with a flat steel top. The Service Caster & Truck Co., 505 N. Brownswood Ave., Albion, Mich.

Protective Coatings

Among the products for protecting and preserving materials used in manufacturing being featured by the newly formed Protective Coating, Inc., are: Aquanil, a non-oxidizing waterproofing material for concrete, stone, wood, brick, and metals; Deox, a metal conditioner; Helfyr, a coating that resists temperatures to 3,000 deg. F.; and Volcazite, which protects metals against all forms of corrosion.

Known as the Tocol line, more than 35 products are available, including protective coating materials to prevent corrosion and to preserve the surface of nearly every known material now being used in manufacture. Protective Coatings, Inc., 10391 Northlawn, Detroit.

Coupling

Type P piloted coupling for floating shaft requirements is especially adaptable for use in paper mills, on steel mill auxiliary drives, on main rolling mill drives, horizontal and vertical pumps, and exhaust draft fans.

Combines resiliency and shock cushioning section of general-duty Steelflex coupling with a low-angle universal joint action, thus eliminating the necessity for an outboard bearing on extended shafts or auxiliary bearings on intermediate shafts. Piloted couplings are made in three types: Single piloted, double piloted horizontal, double piloted vertical. The Falk Corp., Milwaukee.

Sensitized Metal

Recently announced by Republic Engineering Products, Inc., 480 Lexington Ave., New York, is completion of a process whereby they are able to supply materials such as steel plate, brass, copper, various steel alloys, as well as plywood and plastics, coated with sensitized emulsion suitable for making photographic copies. Some of these materials can be secured in any commercial thickness such as ⅛ or ¼ inch cold rolled steel—the type used for making templets. Drawing is photographed directly on the sensitized surface and then developed, saving time because it is not necessary to sketch the drawing on the templet by hand. REP sensitized metal is also suited for name plates, instrument dials, escutcheon plates, and permanent instruction sheets.

The Fifth Column is at work!

WITH all the subversive treachery of the Fifth Column, countless unseen roof leaks may be threatening to sabotage machinery, raw materials and finished products right in your own plant today. You'd better check up and find out.

There's far too much at stake now to run risks with inferior roofing. Many, many firms are insisting on Trinidad Native Lake Asphalt roofing for every inch of plant operation. They know that there's nothing better than this splendid tough old asphalt from the Island of Trinidad.

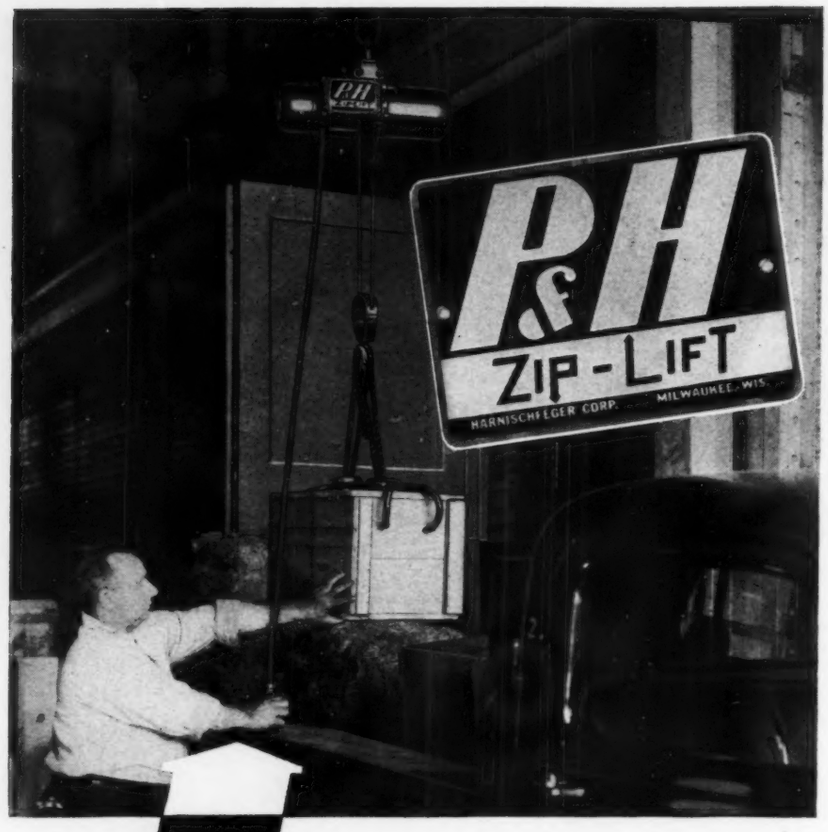
The only way you can be sure of getting Trinidad Lake Asphalt is by insisting on Barber Genasco Roofing. Barber is the sole miner and producer of this asphalt in the United States. Barber alone uses it to make top-quality roofings that sell at competitive prices.

You may buy Barber Bonded Built-Up Roofs—either slag or smooth-top — with 10, 15 or 20 year bonds. Barber also makes several excellent types of roll-roofings with either mineral or smooth surface. All may be obtained with the plus-protection of Trinidad Native Lake Asphalt. Call your near-by dealer or applicator. His name is in your local classified telephone directory. Barber Asphalt Corporation, Barber, New Jersey.

BARBER PRODUCTS

BARBER

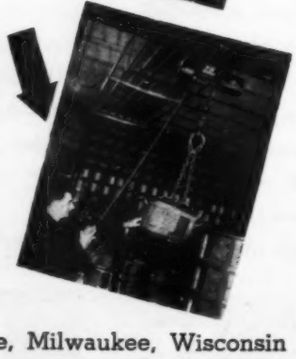
MEANS A GOOD ROOF!



Try This in Your Shipping Room

What a difference it makes when the loading or unloading of trucks becomes an almost automatic operation—without effort—without strain—without waste of time. Here, one man does it all, simply by pressing buttons.

...Machine Shop Heavy parts go to and from machines, smoothly and accurately — without operator fatigue. "Spot Handling" like this lets men and machines produce more.



Or Storage Rooms These are just a few of the many places where the Zip-Lift saves money with fast "through the air" handling of materials. It costs surprisingly little, too! For the Zip-Lift is the only real wire rope hoist in the low price field with full magnetic push-button control. Just hang it up by hook, bolt, or trolley and plug into any standard electrical circuit.

An interesting bulletin called "Handle It Through the Air" shows many other ways a Zip-Lift saves and earns money. Write for Bulletin H-20.

General Offices: 4525 West National Avenue, Milwaukee, Wisconsin

HARNISCHFEGER
CORPORATION
HOISTS • WELDING ELECTRODES • MOTORS P&H EXCAVATORS • ELECTRIC CRANES • ARC WELDERS

Power Trucks End Human Push and Pull

(Continued from page 58)

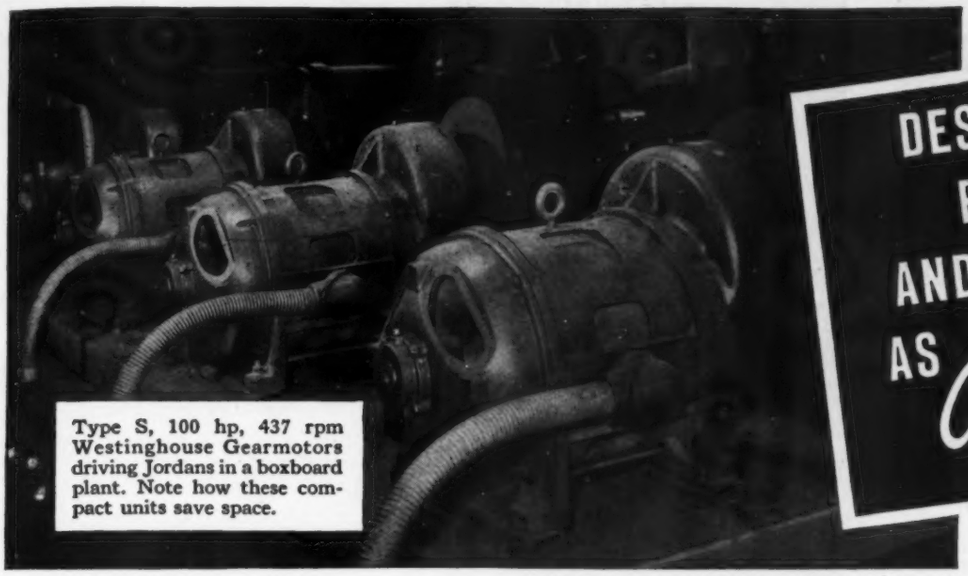
seldom get into trouble, we have found. The one difficulty most often encountered arose from a trucker taking a corner at high speed, thus sliding off the skid loaded totebox he was carrying. We now get away from this by using a skid frame made with four angle-iron legs. When the frame is set accurately upon the skid, the angle irons catch it at each corner so that it is effectively prevented from moving independently of the skid.

For each part that requires care in handling—which means, by our standards, practically everything from a rough casting to a finished part—we have established a standard method of loading the box, tray, or skid. It is up to each trucker to know the proper loading method for each type of article that leaves or arrives at his department. His practical use for this knowledge is to comply with the standing rule of the transportation department that no trucker may move anything unless it is properly loaded. If the truck operator finds a skid improperly loaded, he leaves it where it is and notifies his foreman. The transportation foreman then gets in touch with the department where the goods were loaded, and explains the necessity for loading as specified.

Moves are indicated to the transportation department by notations on the "shop traveler," a job-and-time-ticket jacket which accompanies each load from the moment it starts on its way until the work is completed and placed in stock or used in an assembly. The operations are listed by sequence on the traveler, and when a load is ready to leave a department the last man who handles it—normally, the inspector—writes upon the traveler the next destination. Unfortunately, not all inspectors write careful, legible hands. More times than not, the trucker had to climb down from his truck to scrutinize the scrawl on the traveler. This took time, and sometimes led to deliveries to strange destinations.

We found a way around this hazard by recently equipping each dispatching station with pads of 5 x 2 labels printed with the department number and name of the departments to which loads are sent. These pads, one for each department to which loads go from a given originating station, are in a rack on the nearest column at the dispatching station, so arranged that all of them are in sight and

WESTINGHOUSE GEARMOTORS



Type S, 100 hp, 437 rpm Westinghouse Gearmotors driving Jordans in a boxboard plant. Note how these compact units save space.

DESIGNED, BUILT AND TESTED AS *Complete* UNITS

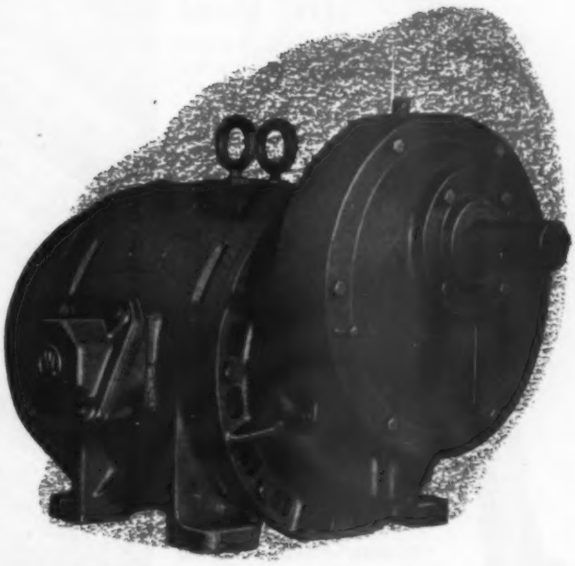
HIGH-SPEED MOTOR EFFICIENCY FOR SLOW-SPEED DRIVES

Westinghouse engineers have made it easy to select an efficient stock slow-speed drive and get maximum performance for all types of applications. With a Westinghouse Gearmotor trouble-free service and low maintenance is assured because Westinghouse Gearmotors are *designed*, *built*, and *tested* as complete units.

Gears, accurately cut from forged steel and heat-treated by the exclusive Westinghouse BPT process, are matched to all other parts and built in as an integral part of the machine.

The high degree of accuracy followed in the construction of individual parts and the careful matching of these parts to form a single compact unit makes it possible for Westinghouse to provide a slow output speed at 94% to 98% efficiency.

Westinghouse Gearmotors are available in all standard motor ratings and a wide variety of special enclosures. Compact and easy to install, they will solve many of your slow-speed drive problems. For complete details, see your Westinghouse representative.



Westinghouse Type S, single reduction gearmotor with explosion-proof enclosure.

WESTINGHOUSE ELECTRIC & MFG. CO.
EAST PITTSBURGH, PA.

J-07169

Westinghouse
GEARED DRIVES

MAKE THE MOST of your "YANKEE" Spirals

. . . To Help DRIVE Ahead

Increase production! Speed up assembly lines with Accessories for "Yankee" Spiral Ratchet Drivers.

"Yankee" Sockets, hexagon and combination, drive bolts, run up nuts, like a flash. Special *Heavy Duty* Sockets made for hex nuts and self-tapping hex head screws.

For slotted screws, "Yankee" Bits with Centering Sleeve automatically place blade in slot.

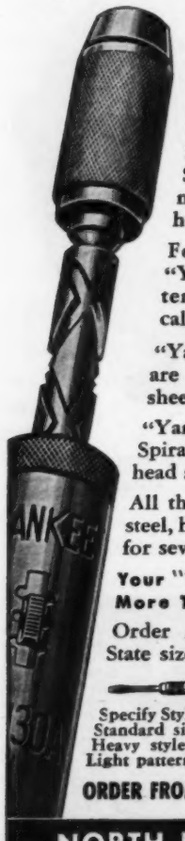
"Yankee" *Heavy Duty* Bits are ideal for self-tapping sheet metal screws.

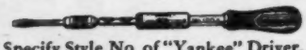
"Yankee"-Phillips Bits for Spirals take care of recessed head screws.

All three styles are of alloy steel, hardened and tempered for severe service conditions.

Your "Yankee" Spirals Are More Than Screw Drivers.

Order Accessories by *name*. State size screws to be driven.





Specify Style No of "Yankee" Driver. Standard size, No. 30A or No. 130A. Heavy style, No. 31A or No. 131A. Light pattern, No. 35 or No. 135. Etc.

ORDER FROM YOUR SUPPLY HOUSE

"YANKEE" HEAVY DUTY SOCKET
"YANKEE" CENTERING SLEEVE BIT
"YANKEE"-PHILLIPS BITS
"YANKEE" HEAVY DUTY BITS
"YANKEE" STANDARD BITS
Order by Style No. on "Yankee" Driver

NORTH BROS. MFG. CO., PHILADELPHIA, U.S.A.

legible. The inspector tears a sheet off the proper pad—say, "44, Turret Lathe Department," and clips it to the traveler. The type is large and legible. The trucker now reads it unerringly without dismounting from his truck. We find that more loads are handled per truck, with fewer errors.

Our most important exception to our rule of "no special skids" is in equipment used to send parts from the stockroom to assembly departments. Finished parts are sent from production to stockroom on ordinary skids, with appropriate carrier devices. There they are unloaded and stored in the stockroom's regular storage bins, on shelves, or whatever is standard for the part. When these parts are needed for use in an assembly department, they are requisitioned out along with all the other parts needed to make the lot called for—say all the parts needed for twenty saddles. To handle these assembly-part loads, the stockroom has racks built right on skids. These racks are pulled from one stockroom aisle to the other on hand lift trucks, and the orders are picked from the shelves and bins onto these racks. Then, the rack goes by electric lift truck to the assembling department where it will be used. When emptied the special rack skid is returned to the stock room for subsequent use.

Finished Lathes Ride Trucks

Even the finished turret lathes are handled on electric trucks. The finished machine is set upon a platform electric truck, is thus carried to inspection and thence to crating and boxing. On this trip, the truck with load traverses the under-street tunnel, and makes two elevator trips. Machines fully boxed for export are handled in a way specially developed for this task. The box is supported at the front by a two-wheeled dolly, at the rear by the platform of the electric truck. Sometimes, for a short move such as across the shipping dock and into a motor truck, one box thus supported is used to push ahead of itself another box mounted fore-and-aft on two dollies.

All eighteen of our electric trucks work the day shift. On the second shift, eight trucks work. On the third shift, three trucks work. Our schedule for trucks is set up so that no electric truck works more than sixteen hours in a day. Thus, each truck gets an 8-hour rest period every day, which is more than enough to permit all necessary maintenance.

A mechanic on the second shift keeps the trucks maintained, repaired, and their batteries fully charged. Since they require relatively little repair work, this is no heavy task for him. At one end of the first floor

"Indoor daylight" in this plant is provided by fluorescent industrial units equipped with 48-inch G-E MAZDA F *Daylight lamps.*

V MEANS VISIBILITY AND VICTORY

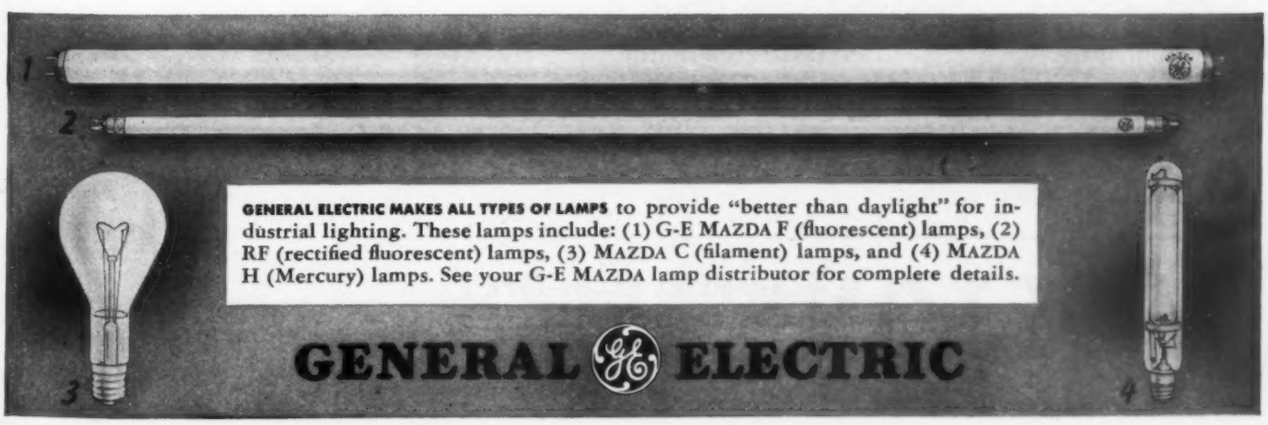
IN MODERN DEFENSE PLANTS LIGHTED WITH G-E MAZDA F "INDOOR DAYLIGHT!"

MORE THAN 50 FOOTCANDLES of cool, even "indoor daylight" floods the screw machine department of this defense industry . . . one of the many plants that are using G-E MAZDA F (fluorescent) lighting to help craftsmen see better and do more accurate work without loss of time and waste through error.

Find out how General Electric can help you speed production, reduce errors, and improve morale in your plant with higher level lighting that is "better than daylight" because it is efficient, economical, and dependable 24 hours a day. Your local electric service company or your G-E MAZDA lamp distributor will show you how to get 50 to 100 footcandles of light, either with incandescent, mercury, RF, or G-E MAZDA F lamps.

• • •

For further information, write General Electric Company, Dept. 166-FJ-I, Nela Park, Cleveland, Ohio.



GENERAL ELECTRIC MAKES ALL TYPES OF LAMPS to provide "better than daylight" for industrial lighting. These lamps include: (1) G-E MAZDA F (fluorescent) lamps, (2) RF (rectified fluorescent) lamps, (3) MAZDA C (filament) lamps, and (4) MAZDA H (Mercury) lamps. See your G-E MAZDA lamp distributor for complete details.

GENERAL ELECTRIC

All-Metal Thermometers

You can mount a WESTON All-Metal Thermometer in any location and at any angle you wish... *without the necessity of correcting for elevation or line temperatures.* That's because the WESTON employs no capillary, no vapors or liquids, no linkage in the drive. *There is but one moving part, and that part is made of enduring, all-metal construction.*

In addition, this simplified and rugged all-metal construction minimizes the inaccuracies or damage from shock or over-ranging ...enables the WESTON to maintain its high initial accuracy (1% over the entire scale) over a far longer period. There are other exclusive advantages, too, which contribute to greater operating efficiency and lower maintenance costs. A bulletin containing complete information gladly sent on request. Weston Electrical Instrument Corp., 628 Frelinghuysen Avenue, Newark, New Jersey.

WESTON (all-metal)
Laboratory Thermometers

The *practical* lab thermometer. Has large, easy-reading scale. Stainless steel construction. Accuracy, ½ of 1% over the entire scale. Ask for bulletin.

WESTON ALL-METAL GAUGE-TYPE THERMOMETERS

is a small bay assigned to the trucks. Here is a charging panel, with three battery-charging units, each with four outlets. Thus, twelve trucks can be charged simultaneously. During the half-hour luncheon period most of the trucks go on the charging panels for battery boosts. During the rest of the day, the charging units are used as needed to bring up the charges of spare batteries. We keep a stock of charged batteries on hand at this point, so that if a truck runs down, it can get a new battery promptly and be about its day's work.

When we are asked for comparative cost figures on moving materials through our plant by electric truck as contrasted with the older, cruder methods we used to use, we throw up our hands in dismay. We simply have no comparative costs, nor do we believe that any such costs we might attempt to compile would mean anything. The facts are simple and easily comprehensible. To us they are convincing enough to remove any doubts about the economical advantages achieved through the use of the trucks.

We move uncounted tons of materials through our plant every day by use of these electric industrial trucks. We keep the flow moving just as fast as we have any use for it, and no department is ever delayed through failure of the transportation department to perform its duties promptly. Aisles are now clean, work does not accumulate around machines. All told, I doubt that we are using a larger number of men for combined hand trucking and power trucking than we used a few years ago for hand trucking alone, when our production was less than 20 percent of what it is today. And, whether or not it were economical, we still could not afford to try to do without the electric trucks. Frankly, without them we could not hope to produce anywhere near the volume of finished machine tools that today we take in our stride.

No Cost Control, No Profits

(*Continued from page 61*)

results every day, compare to bogeys, and display on bulletin boards.

3. Establish repair, reclaiming, or welding allowances for finishing defective work. Compare allowances with results every day.

Expense Control

1. Regard no cost as fixed or sacred. From 30 to 50 percent of "fixed cost"

Noise in a crane is an unfailing sign that vital parts are rubbing together. The inevitable results are wear, excessive maintenance, frequent repairs, and time-consuming crane shutdowns.

Whiting cranes have special design features that reduce noise and consequent wear. For example, instead of ordinary spur gears, Whiting cranes have precision-cut, smooth-running herringbone gears. These gears outlast ordinary spur gears at least two to one. Then too, Whiting cranes have flexible couplings which transmit motor power without binding. Tapered-tread drive wheels assure free bridge travel.

Listen to an ordinary crane, then listen to a Whiting crane. Its extra quietness testifies to its longer life. Whiting Cranes are available in capacities from one to 400 tons. Also electric hoists from ½ to 7½ tons. Whiting Corporation, 15689 Lathrop Ave., Harvey, Ill. *Builders of quality cranes for over 50 years.*

Send for Booklet "How to Write a Traveling Crane Specification." Free to production executives.

Roller Bearings Reduce Noise and Wear in WHITING CRANES

Heavy-duty roller bearings keep all gears in permanent alignment and thus reduce wear. Their smooth, frictionless operation also prevents high starting loads and makes possible faster acceleration.

WHITING *Quiet-Running*

OVERHEAD TRAVELING CRANES

You are now facing an entirely new set of materials handling and product washing problems.

To keep shells and cartridges flowing in an endless stream, you need this new type A-F conveyor system. (Notice the concave rollers).

To wash, rinse and dry shells, cartridges, gun barrels and other defense products efficiently and more economically, we have produced new types of efficient machines never dreamed of before the present emergency.

Whatever your materials handling or product handling problem — whatever your product washing problem — our engineering staff, backed by 40 years of producing "scientifically planned" equipment, can help you to greater efficiency and lower costs.

Write, wire or phone, without obligation on your part, for a discussion of your defense production problems — or for new, illustrated catalogs, featuring A-F Scientifically Planned Conveyors and Industrial Washing Machines for endless stream production — today.

The Alvey-Ferguson Co.,
114 Disney St., Cincinnati, O.

CONVEYING A-F MACHINERY

ALVEY-FERGUSON
INDUSTRIAL WASHING MACHINES
AND Conveyors

is generally subject to management control. Even rent, taxes, insurance, can be reduced on occasion.

2. Budget and check your consumption of power, gas, and water. All can be sharply reduced when systematically studied.

Now glance back at the chart of the three sales dollars (page 60) and visualize how yours might appear if you (1) kept every schedule; (2) met all labor estimates; (3) used only standard materials in proper quantities; (4) held scrap to bare minimums; and (5) controlled expenses regardless of volume variations. Do you see a possibility of increasing your margin of profit if you do all these things?

Cost cutting has its place, and far be it from us to infer that cost control or anything else should interrupt or interfere with logical programs of betterment. But, regardless of contemplated improvements or changes, if you are not currently controlling all costs via the standards-comparisons-incentives route, you are overlooking the surest and most direct method of increasing your company earnings. It does not call for money expenditure. It simply requires constructive planning and a cooperative follow-through.

Foremen "Eat Up" This Work-Simplification Course

(*Continued from page 64*)

a complaint about the quality was received from the customer. The complaint referred to pieces that had been made the old way. Evidently, when buffing the rollers by hand on an abrasive wheel, enough rubber had been removed in certain spots to prevent the sides from being parallel. The new method not only reduced the cost but also definitely insured parallel sides. And so the problem had actually been licked before the complaint was made.

This helps to show that a motion study approach will sometimes result in more than direct labor savings. One new method ended with material savings five times as much as the savings in direct labor.

Some of the job improvements hinged on machine design. The question was raised as to why the engineers responsible for equipment design were not included in the course.

Inspect, rest, and *delay* motions were presented.

Meeting No. 13

Balance delay, use, change directions, and plan completed the study of motions. More pictures were

"GULF Engineering Service is helping increase our output in three ways"

— says this Superintendent

"WHEN I called in a Gulf engineer recently, I knew we would secure sound lubrication recommendations," says this superintendent. "But I didn't expect Gulf Engineering Service to help us in so *many* ways. Look what we're getting: (1) Improved lubrication, (2) Improved equipment performance, (3) Reduced 'down-time'—and these all add up to a *considerable boost in output!*"

Scores of plants in every industry find that they get *real tangible help* from Gulf in the "battle for production." *Your* plant, too, can benefit from the cooperative services extended by the specialists on Gulf's large staff of trained engineers—Gulf Engineering Service can assist you to install efficient lubrication—and Gulf Periodic Consultation Service can offer useful operating suggestions and help you maintain production at peak efficiency.

Gulf quality lubricants are quickly available to you through more than 1200 warehouses in 30 states from Maine to New Mexico. Write or 'phone your nearest Gulf office today.

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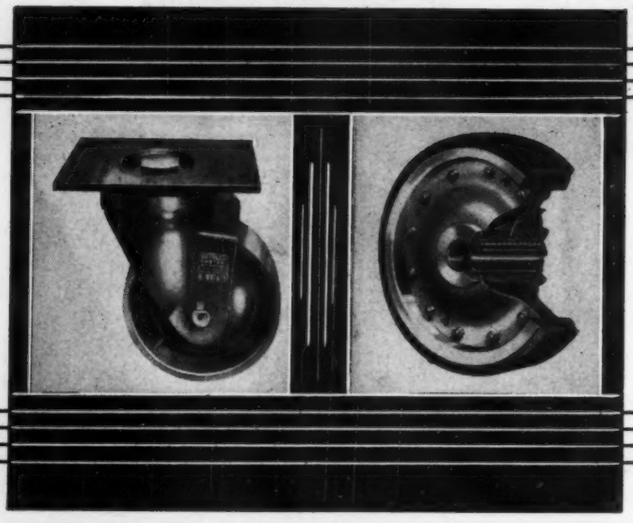
GULF OIL CORPORATION · GULF REFINING COMPANY
GULF BUILDING · PITTSBURGH, PA.

Specify Darnell for Complete Satisfaction



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shown of old and new ways of doing a job. Proper seating was stressed. In many of the pictures, full-view shots were obtained of the operators. These operators were brought in with their foremen and given a chance to view the pictures. This procedure was a great aid in installing the new way. A new application of a previously suggested idea, which showed even better results, was demonstrated by one of the foreman.

Meeting No. 14

The climax of interest had been reached. It was decided to make this the last meeting and to turn the foremen loose with a new perspective. Their interest was so high that many of them regretted to see the completion of the conferences. The formal training was ended with a thorough discussion of motion study and the democratic process.

"Dessert"

The program was capped for this particular group with a banquet and graduation exercises. The trainees provided the entertainment, and certificates indicating the completion of the course were presented. What were the results? During the instruction period, 30 improved methods were suggested, 18 of which had been installed at the completion of the course. The labor cost reduction varied from 4½ percent to the complete elimination of one operation. The average was 47½ percent. The ratio of dollar savings to the cost of new equipment, gadgets, and rearrangements on the improved jobs was 13 to 1. Above all, no labor difficulty had been encountered in installing these economies.

Perhaps the greatest incentive towards getting new ideas was the method of giving recognition to the foreman for simplified work. In some instances the difficulty obtaining the necessary equipment changes created a bottleneck. This seemed to be one of the greatest disadvantages, because of the discouraging effect it had on the foremen who saw a good idea held up.

There was no way of counting the instances where motion economy principles were applied on new jobs as they went into production. Perhaps the greatest value of the instruction lies in that phase. In the final report it was stressed that the failure of a man to receive a write-up did not mean that he had not used the information received to good advantage.

Not to be overlooked is the improvement obtained in other than labor savings. In many instances, the effort resulted in a safer way, better quality, reduction of waste, conserva-

BOTH SAY — "USE BARRELED SUNLIGHT"

Any plant—large or small—can afford to paint with Barreled Sunlight!

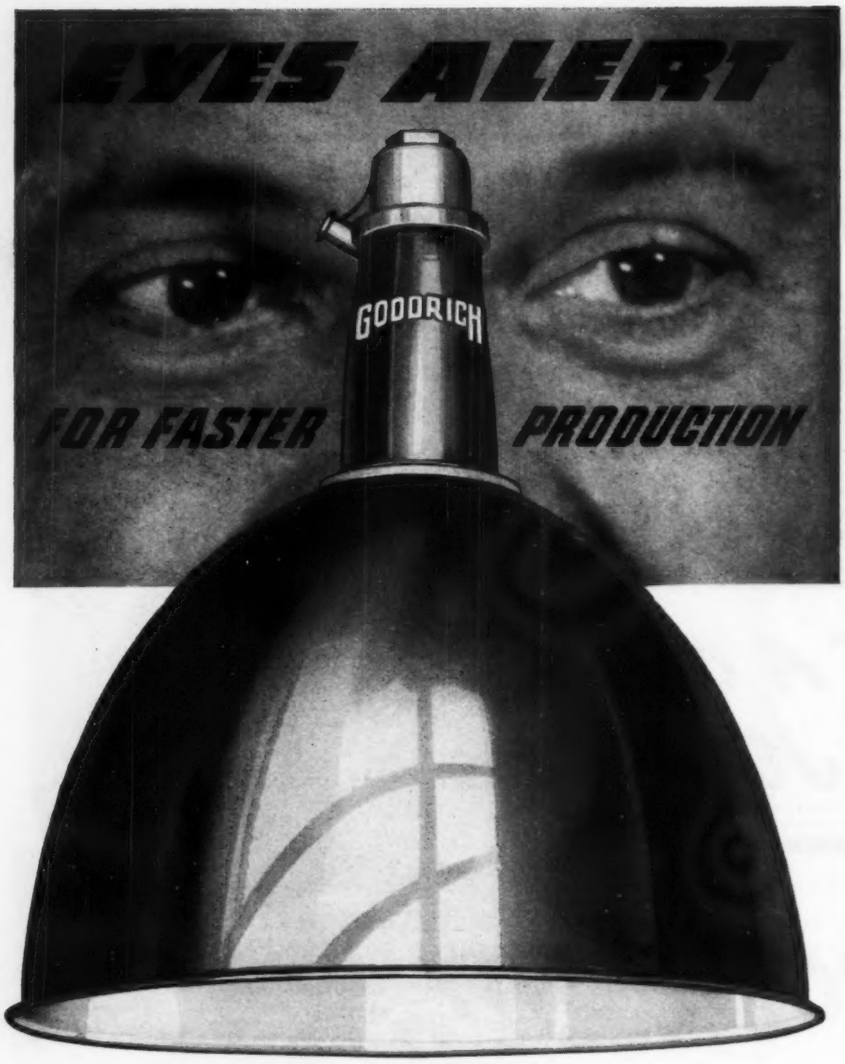
Long known as one of the finest industrial paints that money could buy, Barreled Sunlight today costs no more than ordinary good white paint. No wonder purchasing agents and maintenance men all over the country agree on this famous white paint for plant interiors!

THREE Barreled Sunlight whites are now available. Each is designed for a specific job . . . made to do that job better and more economically. And to find out just which one is best suited for your particular needs, call in your Barreled Sunlight Representative. He'll *inspect* your plant . . . show you how the right Barreled Sunlight will give you greater savings than you've ever enjoyed, yet deliver a finer, whiter, longer-lasting job. Send for free booklet—"The Right Paint for Your Plant." U.S. Gutta Percha Paint Co., 2-J Dudley Street, Providence, Rhode Island.

UNMATCHED FOR 40 YEARS, **Barreled Sunlight *stays* first in the white-paint field because of never-ending research. Working with the secret Rice Process—*which cannot be copied* because it *defies chemical analysis*—Barreled Sunlight chemists have made Barreled Sunlight whiter and whiter, and given it far greater white retention, flowing, spreading and hiding powers. And because of this same research, you can buy Barreled Sunlight for the same price you'd pay for any ordinary good white paint.**

BARRELED SUNLIGHT

SPECIALISTS IN WHITE PAINT FOR INDUSTRY FOR 40 YEARS



HIGH BAY REFLECTOR

HERE'S the fixture that's setting new high levels of general illumination in many vital defense plants—providing the better vision that saves time and speeds up production.

Finished in permanent porcelain enamel, this new Goodrich High Mounting Fixture gives good diffusion, minimizes glare, softens shadows and spreads a uniform high intensity of light over a large working area.

Available in several styles; shown above with Goodrich Diskonect Hood for easy installation and servicing.

Catalog sheets on request.

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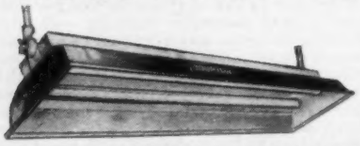
INDUSTRIAL LIGHTING

RLM



GOODRICH FLUORESCENT FIXTURES are offered in a variety of styles and sizes for varying requirements. Write for catalog sheets on the complete line.

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GOODRICH
ELECTRIC COMPANY
OFFICES IN ALL PRINCIPAL CITIES

GENERAL OFFICES AND FACTORY: 4604 BELLE PLAINE AVENUE, CHICAGO, ILL.

tion of floor space, and a more orderly department.

All this was made possible primarily by the splendid cooperation and enthusiasm of the men in the classes, and their superiors. Since the course was completed the rate of improvements has increased steadily. The delegation of one foreman to work simplification duties has made possible most of these time- and labor-saving improvements.

Production Control In Building Subs

(*Continued from page 75*)

men will have the identical instructions he received from the office.

Attached to this card he finds his materials requisition, ready to hand to materials stores, covering all the material needed to perform the work. No more picking this material off the blueprint and taking time out to write out the requisition for the material, or having one of his men do it. In lining up the work for the next shift, he selects jobs from the cards he receives, and turns them over to the night foreman, who then has complete instructions, in writing, about the work to be done.

If material has to be delivered by the regular pick-up truck, a delivery card also has to be attached to the foreman's work order. This is a duplicate of his regular card, but a different color, with "delivery ticket" printed on it in large type. This card is placed with the material and tells the truck driver where to deliver it. The department receiving the material gets the card and knows where the material came from, and how much, as well as a brief description, order number, and blueprint number. This saves the workman's time, because if this slip were not attached he would have to write out the information by hand.

One problem remained. That was control of the whole system. All this work would be time wasted if some method of checking on the foremen were not worked out. For example, if a department should fall a week or two behind schedule, the foreman would become discouraged and finally resort to the old practice of having his men work on the jobs in front of them, or some particular job that someone called to his attention. However, the more he gets behind, the worse the situation gets, until management has to dig in and try to straighten out the mess.

The answer turned out to be quite

simple. A follow-up card, a duplicate of the one given the foreman, except for the color of the stock on which it was printed, is made out. Then the foreman's card is filed in the foreman's rack under the date the job was to be started, the follow-up card in the follow-up rack under the date the job was to be completed.

When the workmen finish a job they return the card to the foreman. He dates it and sends it to the production office. The production department can go to the follow-up rack and, by looking at the finish date on the foreman's card, know under what date the follow-up card was filed, and pull it.

A copy of the complete order is filed in the production office. The date stamped by the foreman on his card is then recorded in the performance column on the order, so we can at all times report to anyone the status of any order.

The foreman's rack gives us a graphic picture of the amount of work ahead of each department.

The follow-up rack shows immediately any job not reported out on schedule, and tells whether a department is running ahead or behind. Two follow-up men watch these racks daily. Their job is to check with the foreman before the finish date of the job, to see if he has been delayed for any reason, and to make sure the job will be completed according to schedule. This constant checking keeps the orders to be worked on in the foreman's mind, so that he, in turn, can keep pushing to be sure to get them out on schedule.

It is necessary at times to re-schedule some orders because of breakdowns, errors, and so on. By having the foremen's cards and the follow-up cards in the production department until work is ready to be performed, it is easy to enter the new schedule dates, and refile them.

Seven Pages for One Order

An interesting comparison of the time saved by this system can be visualized by the following:

A typical order for a watertight bulkhead for the boat requires seven pages for the complete order, with the equivalent of 918 five-letter words. However, of all these words only 81 need changing every time the order is re-issued. Therefore, in re-issuing the order only 9 x 81 or 729 words have to be written. If the entire order had to be written nine times, it would require 918 x 9 or 8,262 five-letter words. To re-issue this order, including writing the extra 81 words, the machine time for running 10 complete copies of the order, running

ALWAYS READY FOR ACTION!

. . . this extinguisher needs no annual recharging

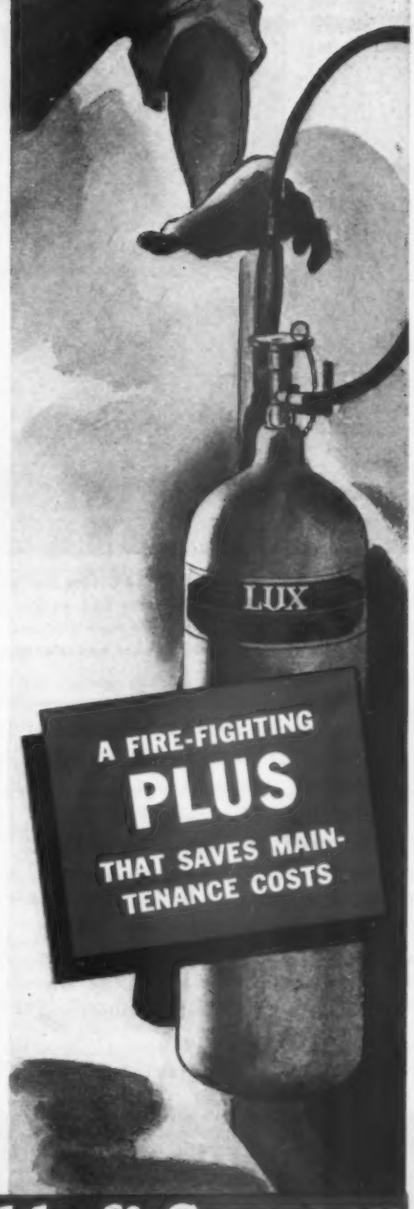
NEXT time you buy extinguishers think twice about maintenance. Many extinguishers require emptying, refilling every twelve months. This costly procedure can't be skipped without running risks in emergencies.

All you need do with LUX extinguishers is *weigh them annually*. LUX carbon dioxide does not deteriorate in the extinguisher, won't corrode parts, or threaten LUX's quick effectiveness when fire breaks out. Weighing tells immediately if any LUX gas has been removed. Most LUX users report that their extinguishers *have never required extra servicing.*

This is another *plus* value in fire fighting brought to you by LUX. You profit from *lower maintenance costs, assured operation* in emergencies.

Here are the PLUS values in fire-fighting

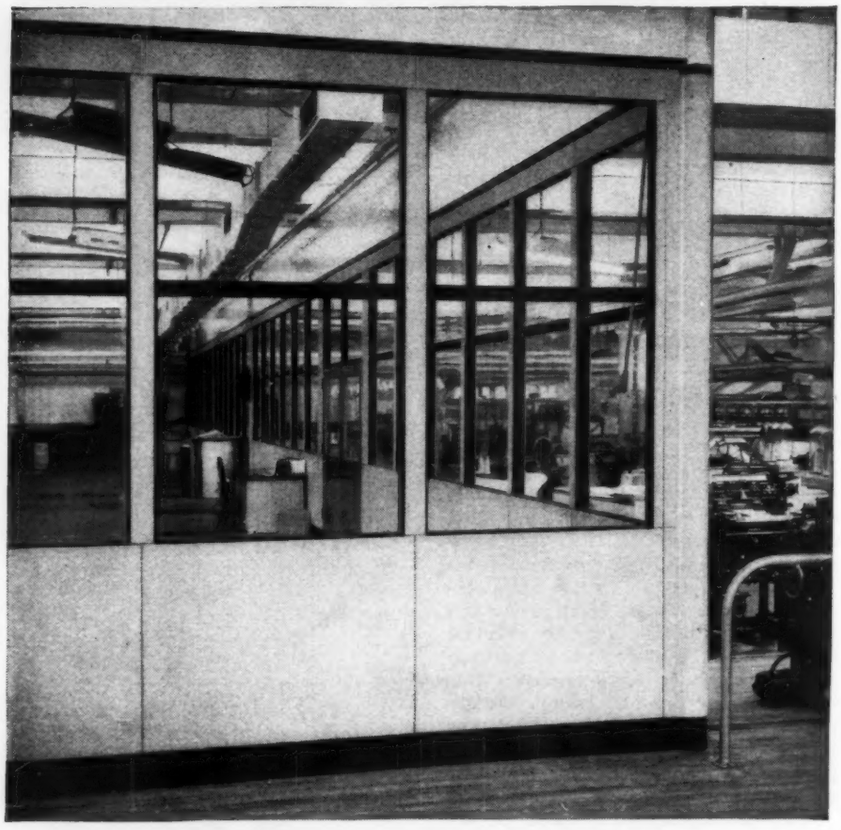
1. LUX carbon dioxide gas is one of the fastest known extinguishing agents.
2. LUX extinguishers are effective on both electrical and flammable liquid fires.
3. LUX gas is clean, non-damaging, non-contaminating, non-toxic.
4. *45,000% expansion* drives LUX gas throughout fire area, despite obstructions.
5. Annual recharging is not necessary with LUX. Simply weigh periodically.
6. LUX service depots are maintained in principal cities.



LUX
SNUFFS OUT FIRE

Walter Kidde & Company
Incorporated
1012 West Street, Bloomfield, N. J.

SPEED UP PLANT OFFICE CONSTRUCTION . . . USE J-M TRANSITE WALLS



ANY TYPE PARTITION can be formed with J-M Transite Walls—free standing, ceiling high, bank screen, solid or in combination with glass as shown above. In all cases, initial installation and relocation are rapid and economical.

THERE'S no excuse for unnecessary delay in building plant offices . . . no need to put up with makeshift arrangements.

For in J-M Transite Walls, you have a partitioning material that goes up fast, forms permanent quarters, yet can be quickly relocated whenever necessary. Made of asbestos and cement, these modern walls are unusually durable, fire-retardant, economical to maintain.

A patented construction method cuts installation time . . . eliminates fuss and dirt . . . assures solidity and privacy. When changes are required, this same method permits offices to be moved from one section of the plant to another in a minimum of time, with complete salvage of materials.

Two types of Transite Walls are available . . . Imperial and Universal. You should have full details on both. Write for Transite Walls brochure TR-22A. Johns-Manville, 22 E. 40th St., New York.

JM Johns-Manville
TRANSITE MOVABLE ASBESTOS WALLS

the cards, materials requisitions, and delivery tickets, everything complete, is about 20 minutes.

The saving in writing is only one phase. When the first order is written, it is proofread to check for clerical mistakes. The words that vary each time are mainly start and stop dates, and if a clerical mistake were made in one of these dates it would not be serious. Therefore, once an order has been found correct for the first boat, there can be no question of the accuracy of the orders for the rest of the boats. With this system further proofreading is unnecessary. Mistakes are always costly and where there is much writing, with figures and so forth, it is easy to make mistakes. We think this system reduces them to a minimum.

All this may sound a bit complicated. However, heretofore every phase of this work had to be done by some individual, with the main burden falling on the foremen or leaders. By eliminating the foreman's paperwork he can spend more time supervising his men and watching for shortcuts to speed up production. "Uncle wants his boats," and Manitowoc has a set-up to see he gets them.

Tests Help You Hire Right

(*Continued from page 80*)

test is very good, even though we have figures to prove it. So, for that reason alone, it is wise to translate or transmute all test scores to a scale where 100 is perfect and 70 is passing when it is at all practical and possible. There are several methods for doing this. We used what is known as "weighting" the test scores.

"Weighing" the "Raw" Scores

"Raw" scores or the number of correct answers in themselves mean nothing unless you have some standard with which to compare them. Looking over the two parts to our test in blueprint reading, made up of 30 questions covering two separate prints, we found that for practical purposes one part answered correctly would mean more towards shop efficiency than the other. So the questions were "weighted" arbitrarily. In the less important part containing 10 questions, each one correctly answered was multiplied by 2. In the more important part of 20 questions, each correct answer was multiplied by 4. Where a subject failed to follow directions, a penalty point of 1 was subtracted. The formula for the final score

NO. 7

ALUMINUM, DEFENSE, AND YOU

THE TIMETABLE OF ALUMINUM FOR DEFENSE

up to September 10, 1941

1938 Sept. *Munich.*
Oct. *Czechoslovakia invaded.*
Nov. Alcoa inaugurates $26,000,000 expansion program.
Dec. Alcoa produced 287 million pounds in 1938; had more than a year's supply on hand.

1938

1939 Jan. New extrusion and tube mill begins operation at Lafayette, Ind.
Feb. Start building an excess stock pile of airplane sheet.
Mar. *Bohemia and Moravia occupied.*
Apr. *Albania invaded; Congress authorizes Army to acquire 6,000 planes by July, '41, and Navy 3,000 by '44. Aluminum for all these would take about two months 1941 production.*
Sept. *Poland invaded; U. S. Neutrality proclaimed; limited National emergency proclaimed.*
Alcoa authorizes new metal-producing capacity at Alcoa, Tenn.
Nov. *Finland invaded; Cash-and-carry act signed.*
Alcoa completes $26,000,000 expansion program, begins plans for a larger one.
Dec. *U. S. protests blockade of German exports.*
New metal-producing plant authorized at Vancouver, Wash.
1939 production 327 million pounds; 215 million on hand.

1939

1940 Jan. *First request for defense appropriation in Budget Message.*
Alcoa announces $30,000,000 more plant expansion.
Mar. Alcoa reduces price of aluminum from 20c to 19c, starts construction of Vancouver, Wash., plant.
Apr. *Denmark and Norway invaded.*
May *Low countries invaded; National Defense Advisory Commission named.*
New metal-producing unit begins operation at Alcoa, Tenn.
June *Dunkerque; France capitulates.*
Additional metal-producing unit authorized at Alcoa, Tenn.
July *Congress lifts previous limits on numbers of planes.*
Aug. *Air offensive against England begins; 50 destroyers exchanged for island air bases.*
Alcoa reduces price of aluminum ingot from 19c to 18c; capacity for making alumina increased.
Sept. *Egypt invaded; Selective Service Bill passed.*
First metal manufactured at Vancouver, Wash., plant and new units for additional capacity authorized.

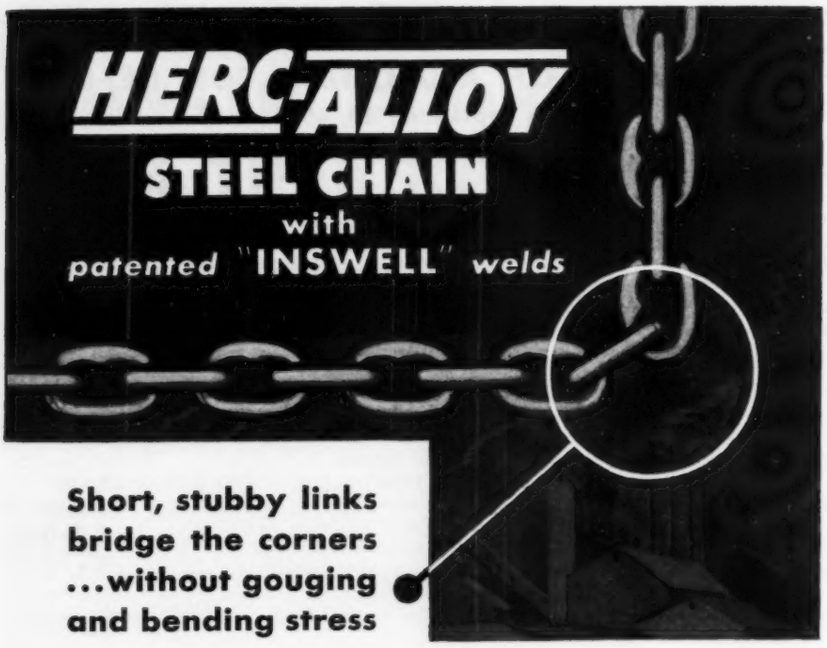
1940

Oct. *Rumania invaded.*
Alcoa authorizes another $150,000,000 for expansion.
Nov. *26 bombers on contract turned over to Britain.*
Alcoa reduces ingot price from 18c to 17c; additional capacity authorized at Badin.
Dec. Alcoa 1940 production 413 million pounds; 154 million on hand.
1941 Jan. *OPM established; NDAC says aluminum supply adequate to meet October, 1940, estimates of requirements.*
Alcoa authorizes additional capacity at Alcoa, Tenn.
Feb. *Aluminum put on priorities.*
Mar. *Lend-lease bill signed.*
Alcoa produces 44,000,000 pounds of metal this month.
Apr. *Yugoslavia invaded; U. S. occupies Greenland.*
May 150 million-pound-annual-capacity plant at Vancouver, Wash., completed and operating at capacity.

1941

June *Crete lost; Russia invaded.*
July *New Government aluminum plants authorized; U. S. occupies Iceland; Japan moves into Indo-China.*
Alcoa produces 53,000,000 pounds this month; Badin unit authorized November, 1940 starts operation.
Aug. *U. S. Government announces Aluminum Company of America will build and operate 3 Government-owned aluminum smelting plants and one for making alumina.*
Alcoa announces ingot price reduction to 15c, effective October 1, 1941.
Alcoa and T. V. A. conclude agreement to unify two great hydro-electric power systems in the Tennessee Valley, which will add at least 200,000,000 pounds to America's annual aluminum producing capacity.
Alcoa produces 54,000,000 pounds of aluminum this month.
Sept. Sites selected for two of the Government-owned aluminum plants and for the alumina plant; railroad, water, and sewage facilities provided; construction contracts being executed.
Alcoa starts construction of 325,000,000 pounds per year additional alumina producing capacity at its own Mobile plant; construction started on additional capacity for 22 million pounds of aluminum fluoride, and 23 million pounds of cryolite annually at East St. Louis; eight new extrusion presses purchased to bring expansion up to 238% of pre-war capacity.
Excess stock pile of aluminum airplane sheet started in February, 1939, being maintained at 5,000,000 pounds.

ALUMINUM COMPANY OF AMERICA



Herc-Alloy Steel Chain with the exclusive patented "Inswell" welds is proving its superiority in every type of application. Fabricated from a special analysis, heat treated steel, the sturdy short, stubby links bridge square corners (see photograph above) minimizing bending stress and gouging... adding extra chain life and economy even under the most punishing assignments.

25% extra margin of safety and wear

Note the extra "swell" of steel at the weld of Herc-Alloy steel chain. With 25% extra metal at the point where strength is vital, these "Inswell" welded links give extra safety to men and materials... and longer chain life. Specify and insist on Herc-Alloy—it's your assurance of extra dependability, economy and safety.

Whether or not you need chain today... *get the facts.* Complete catalog on request and trained *CM* engineers are available for consultation. Write:

COLUMBUS-McKINNON *Chain* CORPORATION

(Affiliated with Chisholm-Moore Hoist Corporation)

130 FREMONT AVE. TONAWANDA, N. Y.

Branch Offices: **NEW YORK · CHICAGO · CLEVELAND**

based on a 100 percent scale was now: *Number of correct answers part 1 x 2, plus number of correct answers part 2 x 4, equals total score.* A perfect paper would be 10 x 2, plus 20 x 4, equals 100. In this test the scores were thus transmuted by "weighting."

In our test we used the multiple-choice question method—that is, we suggested several answers to each question. The subject reads the questions, then studies each answer to find the right one. Each suggested answer is numbered. When the subject chooses his answer he places its number in the parenthesis at the end of the dotted line. Each question answered is either right or wrong, and is not a matter of judgment to the scorer. For quick scoring, the scorer uses a stencil (see Figure 6), which is simply a piece of cardboard with the correct answers printed along the margin. In actual scoring this stencil is placed along the edge of the test paper in such a manner that the correct answers and the subject's answers can be compared with ease. The wrong ones can then be checked and counted with small chance of error.

The multiple-choice type of question has one fault. Because of the suggested answers in which one is the right one, a person may, by guessing, make a higher score than he should have made. However, chance can be reduced by increasing the number of suggested answers and making several close to the right answer, so that the applicant must "know his stuff" to get the correct answer. It also helps to ask the subject to place an x inside the parentheses when he does not know the correct answer. All in all, the good points of this type of test outweigh the poor ones.

Divided into Quartiles

The results of the tests made on pupils in the two blueprint classes plus the scores taken from a group of men tested in our shops were divided into quartiles. The total number of scores were divided by 4. For example, if there were 100 scores, then there would be 25 scores to each quartile. The highest group of 25 scores comprised the first quartile, or the *excellent* group. The next 25 scores were the second quartile, or the *good* group, and so on until the third and fourth quartiles were complete. Score groups appear like this:

Final Score	*Quartile*	*Classification*
93-100	First	Excellent
85- 92	Second	Good
70- 84	Third	Fair
30- 69	Fourth	Poor

An applicant receiving a score of

WANTED
Production-Run
Defense Work
Two Large Plants, Over Half a Million Square Feet of Manufacturing Space. 40 Years' Experience Perforating, Blanking, Forming, Assembling, Enameling and Lacquering Sheet Metal in Gauges No. 10 to No. 24

★ Located in the heart of the Middle West . . . fully manned with skilled workers . . . in addition to assembly plants on both Coasts . . . and 13 strategically located District Offices, manned by experienced engineers, Lyon offers an efficient set-up to help manufacturers with their defense production problems.

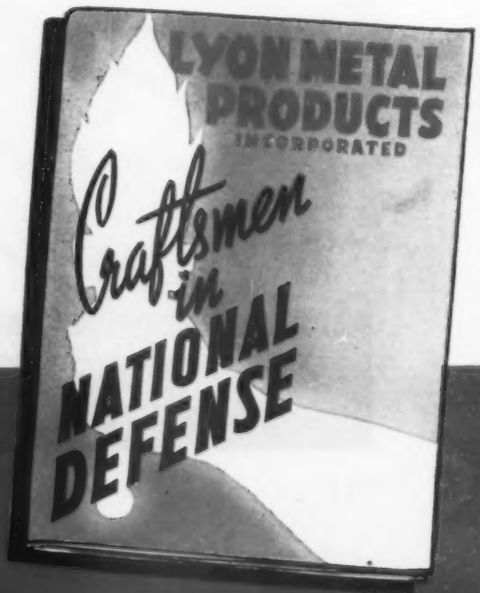
Plant facilities include shears, punch presses, double crank presses, power brakes, spot, arc and gas welders, baking ovens, washing machines, dip tanks, spray units and other specialized equipment exactly suited to the fabricating of sheet metal in Gauges No. 10 to No. 24. Each plant is equipped with a modern toolroom, organized to produce necessary dies and jigs to service all production equipment.

Complete and specific details on Lyon facilities for producing special defense products . . . either as a prime contractor or sub-contractor . . . are available in a fully illustrated brochure. Write or wire today for a copy.

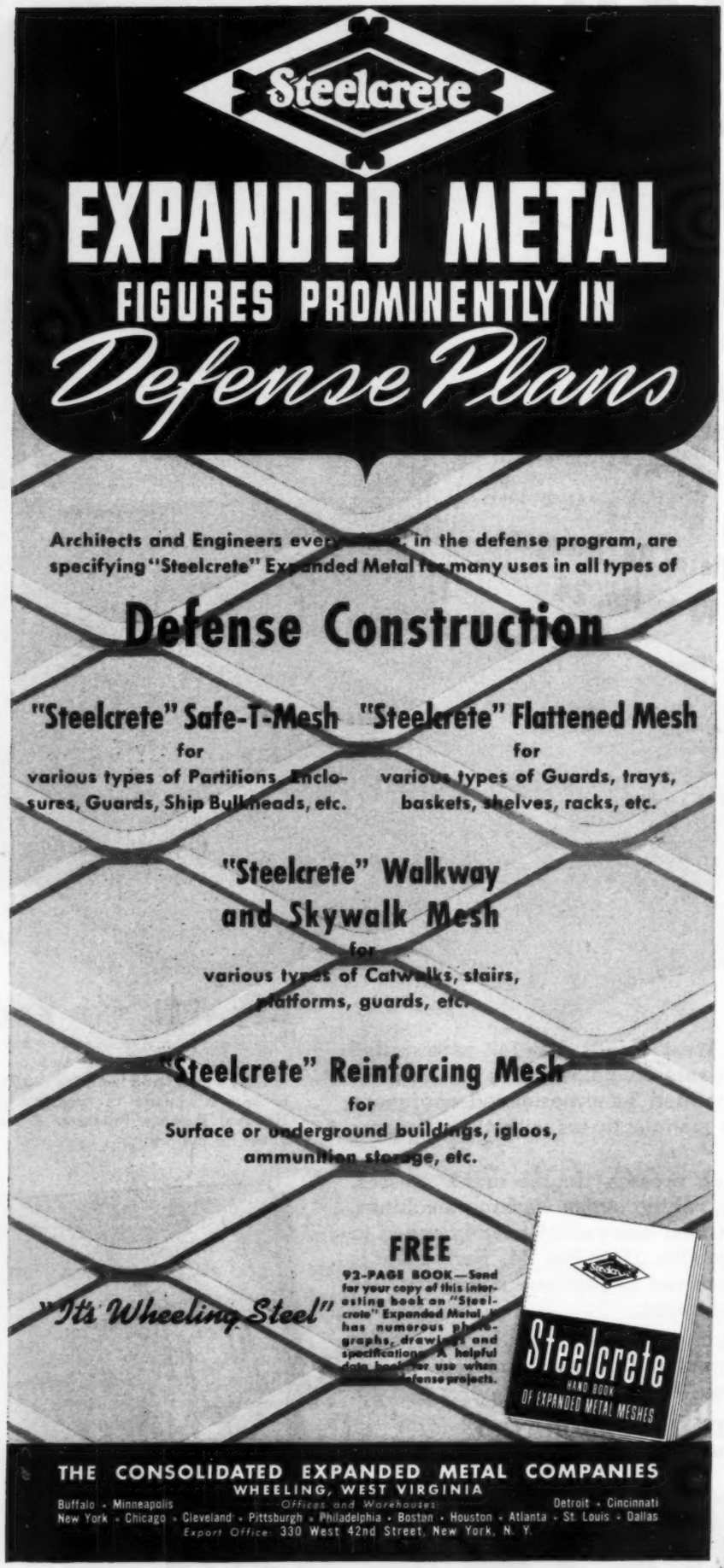
LYON METAL PRODUCTS, INCORPORATED
General Offices: 1210 Madison Avenue, Aurora, Illinois

GET ALL THE FACTS

This comprehensive brochure has been prepared to simplify the task of determining where Lyon facilities can be used to best advantage in accelerating the National Defense Program. A copy is yours for the asking.



LYON METAL PRODUCTS, INC.


Steelcrete
EXPANDED METAL
FIGURES PROMINENTLY IN
Defense Plans
Architects and Engineers every[illegible], in the defense program, are specifying "Steelcrete" Expanded Metal for many uses in all types of
Defense Construction
"Steelcrete" Safe-T-Mesh
for
various types of Partitions, Enclosures, Guards, Ship Bulkheads, etc.
"Steelcrete" Flattened Mesh
for
various types of Guards, trays, baskets, shelves, racks, etc.
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for
various types of Catwalks, stairs, platforms, guards, etc.
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for
Surface or underground buildings, igloos, ammunition storage, etc.
"It's Wheeling Steel"
FREE
92-PAGE BOOK—Send for your copy of this interesting book on "Steelcrete" Expanded Metal. It has numerous photographs, drawings and specifications. A helpful data book for use when [illegible] defense projects.
Steelcrete
HAND BOOK OF EXPANDED METAL MESHES
THE CONSOLIDATED EXPANDED METAL COMPANIES
WHEELING, WEST VIRGINIA
Offices and Warehouses:
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Export Office: 330 West 42nd Street, New York, N. Y.

85 on the test is in the second quartile and is considered as having a good score as compared to men who had actually studied the subject or had actual experience in the shop. These "norms" or so-called standards may be considered only tentative, and may be revised like the critical score when more data have been built up.

Practical Application

The greatest of all tests of a test is its practical application, and whether better results are obtained by using tests as supplementary to the more usually employed interview method of hiring new help.

At first no attention in selecting help was paid to the test scores.

Large groups of applicants were tested at one time with the cooperation of the Vocational School director, who supplied the room with a large seating capacity. Men were hired after passing the interview and physical examination stage. Shortly after a new group of men had been hired, Foreman A came into the office and stated a certain man had been able to handle an assembly job by himself after one month on the payroll. Ordinarily, he claimed, it took from six months to one year to accomplish the same results with the average man. The job required a definite knowledge of blueprints. We looked up this man's score. It was 93!

Foreman B of a welding department wanted to discharge one man because, even though he was a good welder, the man could not follow a print. We looked up his score. It was 16! We hear other stories of the same nature and, although we cannot put down a coefficient or correlation highly positive to a set of criterion scores, which is a method used by psychologists in proving tests based on scholastic achievement, we feel the test is a decided improvement or addition to our old method of selecting help.

Many Factors Studied

Factors that enable one man to get a better score than another were studied. We correlated such items as test scores with age, years of mechanical experience, years of schooling, amount of mechanical drawing taken in school, etc. All the coefficients were positive. The highest was the amount of mechanical drawing taken in school. This is logical, as blueprints are reproductions of mechanical drawings. However, the coefficient was not high enough to say in general that any person who took a course in mechanical drawing would get a high score on reading a blueprint. As has been often said—a test score better shows what a person *can* do than what he *will* do.

RELIABLE FUSE PROTECTION IS ESSENTIAL FOR MAINTAINING PRODUCTION

In America more electrical horsepower is behind our man-power than in any country in the world.

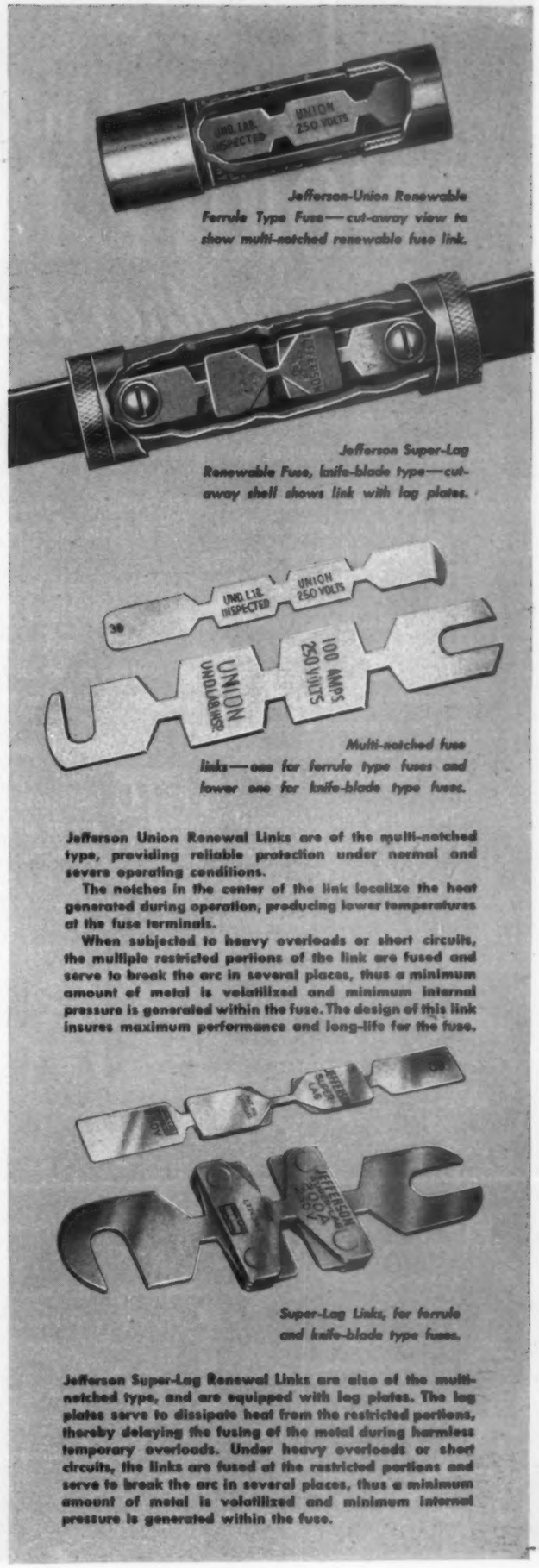
Keeping that horsepower on the job is vital—motors and machines must be kept going. Proper fusing eliminates unnecessary shut-downs and damage to motors, wiring and equipment.

Jefferson Renewable Fuses provide the safe, reliable protection needed... they prevent needless interruptions and guard against damage to equipment.

When excessive overloads require these fuses to open the circuit, they do it safely and reliably. Their rugged construction and simple design permits quick and proper cleaning, and renewing with ease.

JEFFERSON ELECTRIC COMPANY
BELLWOOD (Suburb of Chicago) **ILLINOIS**
Canadian Factory: **60-64 Osler Avenue, W. Toronto, Ontario**

JEFFERSON ELECTRIC
Renewable
UNION FUSES SUPER-LAG



Jefferson-Union Renewable Ferrule Type Fuse—cut-away view to show multi-notched renewable fuse link.

Jefferson Super-Lag Renewable Fuse, knife-blade type—cut-away shell shows link with lag plates.

Multi-notched fuse links—one for ferrule type fuses and lower one for knife-blade type fuses.

Jefferson Union Renewal Links are of the multi-notched type, providing reliable protection under normal and severe operating conditions.

The notches in the center of the link localize the heat generated during operation, producing lower temperatures at the fuse terminals.

When subjected to heavy overloads or short circuits, the multiple restricted portions of the link are fused and serve to break the arc in several places, thus a minimum amount of metal is volatilized and minimum internal pressure is generated within the fuse. The design of this link insures maximum performance and long-life for the fuse.

Super-Lag Links, for ferrule and knife-blade type fuses.

Jefferson Super-Lag Renewal Links are also of the multi-notched type, and are equipped with lag plates. The lag plates serve to dissipate heat from the restricted portions, thereby delaying the fusing of the metal during harmless temporary overloads. Under heavy overloads or short circuits, the links are fused at the restricted portions and serve to break the arc in several places, thus a minimum amount of metal is volatilized and minimum internal pressure is generated within the fuse.

Looking at this PRIORITY THING *from another angle*

Ingenuity, not just more men, machines and material, is a way out of priority delays. "Dag" colloidal graphite conserves vital material and relieves production bottlenecks.

Savings up to fifty per cent reported on assembly and run-in of tool machines and engines—Bulletin No. 112V

Forging die life increased - Used as a parting compound and lubricant, "dag" colloidal graphite improves finish and reduces scrap in die casting; foundry, glass, rubber, and bakelite molding—Bulletin No. 130V

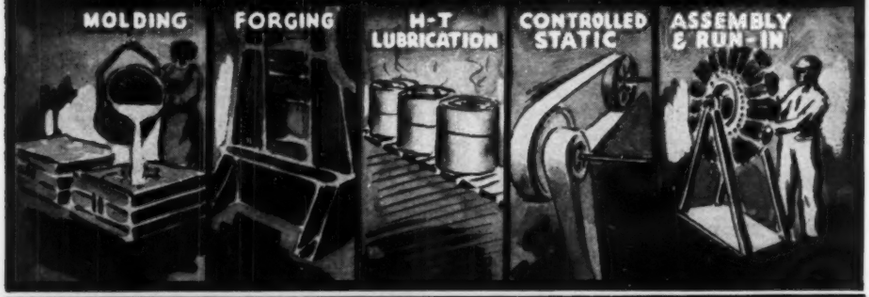
On belting "dag" colloidal graphite bleeds-off static, reducing explosion hazard—Bulletin No. 270V

"Dag" colloidal graphite takes over the load of lubrication at 400° F. and upwards, temperatures at which petroleum oils burn—Bulletin No. 130V

Ask your oil supplier about his "dag" colloidal graphited lubricants and write us for any or all of the bulletins described above.

ACHESON COLLOIDS CORPORATION
PORT HURON, MICH.

"Dag" is a registered trade mark of the Acheson Colloids Corporation



Here are a few of the many uses of colloidal graphite in industry—check any with which you may be having lubrication difficulties.

"DAG" COLLOIDAL GRAPHITE FOR:

CONVEYORS	SCREW THREADS
FORGING DIES	STEAM CYLINDER
COMPRESSORS	CASTING
GLASS MOLD	CONDUCTIVE COATINGS
ASSEMBLY AND RUN-IN	IMPREGNATION

Tear off this coupon and attach to your letterhead—it will bring a working sample for the uses you specify.

ACHESON COLLOIDS CORPORATION • Port Huron, Michigan

Management Shorts

(*Continued from page 76*)

worked very nicely when the work was on the operator's left side. It so happened, however, that there was one class of work that had to be fed in on the operator's right side.

This made it necessary to add a helper whose principal duty was to trip the foot pedal. The addition of this one man did not appreciably increase production, so was just extra cost that could not be justified.

The first step toward improvement was to install a pedal on the left-hand side of the machine with a bar extending from the right pedal to the left pedal—a distance of about 8 feet. The idea was to eliminate the extra man, and this was done. This pedal, however, was not of the proper design and we used to have considerable trouble with it.

We then removed the left-hand pedal. A frame about 10 inches wide by 8 feet long was welded together. The outside of this frame is a channel while the inside bar is round. On the 8-ft. length there are four supporting crosspieces, one on each end and two in between. A hole was drilled through the top channel of the frame. By means of a long bolt, the frame is suspended underneath the pedal in a loose fit.

The round bar side of the frame is fastened to the floor through bushed holders which are screwed into the floor. The top of the channel is the operating step plate for the entire 8-ft. length, and the round bar part of the frame acts as a hinge.

This arrangement has eliminated the need for an extra man because the operator can trip the machine no matter where he stands.

•

Pallet Handling Reduces Loading Time

SOURCE: Clark Trucktractor Division of Clark Equipment Company, Battle Creek, Michigan

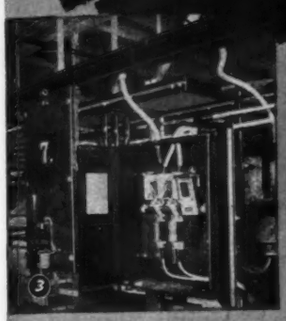
A Pittsburgh concern manufactures masonry units by a new process that involves curing the cast product while still in the molds. An important step of the manufacturing operation is the aging process, which means storing the blocks under cover when they are released from the molds.

Formerly the product was handled by hand, piled in the aging rooms, later hand-trucked to loading docks.

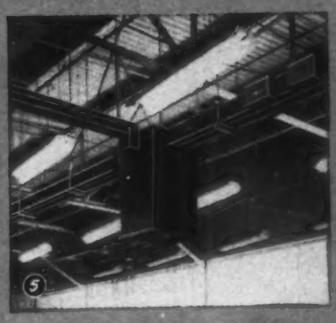
The introduction of the pallet method of handling has resulted in an important reduction in costs. Sixty blocks are piled on a pallet as they are released from molds. Pallet loads are stacked two high

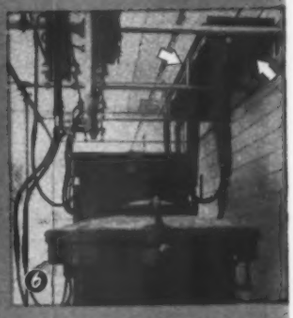
THIS NEW PLANT "Has Everything" FOR FLEXIBLE "PLUG-IN" LIGHT AND POWER

[1] From this outside Transformer Bank No. 1 (3-500 KVA, 3 phase, 220 volts), a short run of Bull Dog 4000 amp. "LO-X" BUStribution DUCT connects transformers through wall to Bull Dog Switchboard No. 1, [2] from which four runs of Bull Dog BUStribution DUCT feed into the plant. One of 1000 amp. "Plug-in" type feeds air compressors and boiler room, one of 1500 amp. "Plug-in" type leads through Maintenance Department and Tool Room to Switchboard No. 2, and

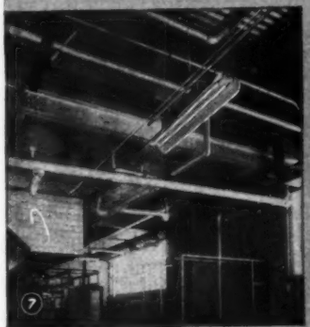


[3] two runs of "LO-X," one of 2000 amp. and one of 1500 amp. feed hydrogen brazing furnaces, as shown above. In the foreground is a run of Bull Dog Khi-Duct enclosing wires and cables for the furnace control panels directly below. [4] This 325 foot run of Bull Dog 1500 amp. "Plug-in" type BUStribution DUCT which ties in Switchboards 1 and 2, also serves as a power plug-in source for the Maintenance Department and Tool Room.





[5] From this long run of 1500 amp. "Plug-in" type BUStribution DUCT, a run of 750 amp. branches off to the left, the tap-off being made through a Bull Dog 3 Pole 800 amp. Circuit Breaker Cubicle Adapter. [6] This Transformer Bank No. 2 (3-200 KVA) feeds Bull Dog Switchboard No. 2, by means of a 1500 amp. "LO-X" BUStribution DUCT through wall at back of Switchboard, which is tied into Switchboard No. 1 by the



[7] run of 1500 amp. "Plug-in" type Bus Duct coming into switchboard from the left. Outgoing run at top of switchboard is Bull Dog 500 amp. "Plug-in" type, while tapping-off from this run in the upper foreground is a run of Bull Dog "125" Bus Duct. [8] Here is a run of 500 amp. Bull Dog "Plug-in" Bus Duct with runs of "125" "Plug-in" Duct, connected by means of Bull Dog Vacu-Break Bus Plugs in the 500 amp. Duct, and Bull Dog End Cable Tap Boxes in the "125" Duct.

[9] Close-up of one of the 147 ft. runs of Bull Dog "125" Duct, and of several parallel runs of Bull Dog Universal Trol-E-Duct, which feed and support the 200 watt fluorescent lights throughout the entire plant. [10] One of twelve Bull Dog Narrow Column Circuit Master Panels which feed and control runs of Bull Dog Universal Trol-E-Duct, connections being made by conduit and Bull Dog FC-2108 Outlet Box.

THESE PHOTOS of this great new defense plant show how Bull Dog Bus Duct systems provide flexible lighting throughout the plant, and flexible power, with various protective "plugs" for each individual machine. Write for Bulletins 403 and 412 describing these modern wiring systems, or better yet, ask for a call from a Bull Dog sales engineer.

BULL DOG
ELECTRIC PRODUCTS CO.
DETROIT, MICHIGAN
Bull Dog Electric Products of Canada, Ltd., Toronto, Ontario

MANUFACTURERS OF Vacu-Break Safety Switches, Circuit Master and SafToFuse Panelboards, Switchboards, Duct Systems—FOR LIGHT AND POWER

Fast Cutting Long Wearing

THREE-M-ITE fibre combination DISCS

Increase Production

Turning out more units is a vital necessity in today's production. That's why Three-M-ite Fibre Combination Discs are being used for cutting down welds, removing nibs and general metal conditioning.

The long wearing qualities of these tough, sturdily made discs give you low cost sanding in addition to speeded-up production. Try Three-M-ite Fibre Combination Discs for your metal sanding jobs.

Made in U. S. A. by

MINNESOTA MINING & MANUFACTURING CO.

SAINT PAUL MINNESOTA

Branches in Principal Cities

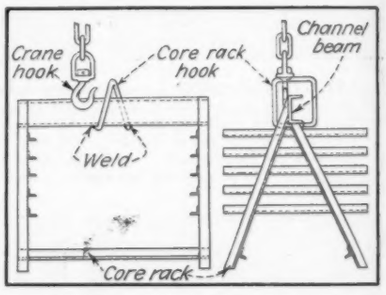
in storage, by the use of a gas-powered finger-lift truck. Where it formerly required the motor truck driver and two laborers from 40 to 45 minutes to load a delivery truck, the truck operator now places 6 pallet loads of blocks (360 units) on the delivery truck in from 12 to 15 minutes. Labor is saved, idle truck time reduced.

•

Rack Guides Crane Hook into Place

ROBERT J. STRONG, Argo, Ill.

Overhead cranes in our foundry are used to lift large ladles of hot metal; also, to distribute a large number of loaded core racks, about 5 feet high, to the molders. When lifting the ladles the crane hooks become so hot that it is not possible to handle them with the bare hands. Formerly, a helper wearing asbestos gloves had to be on the ground constantly, attaching the hooks to the core racks. If this man was not around the crane had to wait until someone else came.



To eliminate this waste of time and manpower a new type of lifting hook was designed for the core racks, as shown in the illustration.

Now the crane operator merely brings the hook against the upper beam of the core rack. When the hook touches the beam it automatically swings parallel with the latter. Then all the operator has to do is move the crane so that the hook slides along the beam and into the hook of the core rack.

This hook made it possible to release the ground man for other work.

•

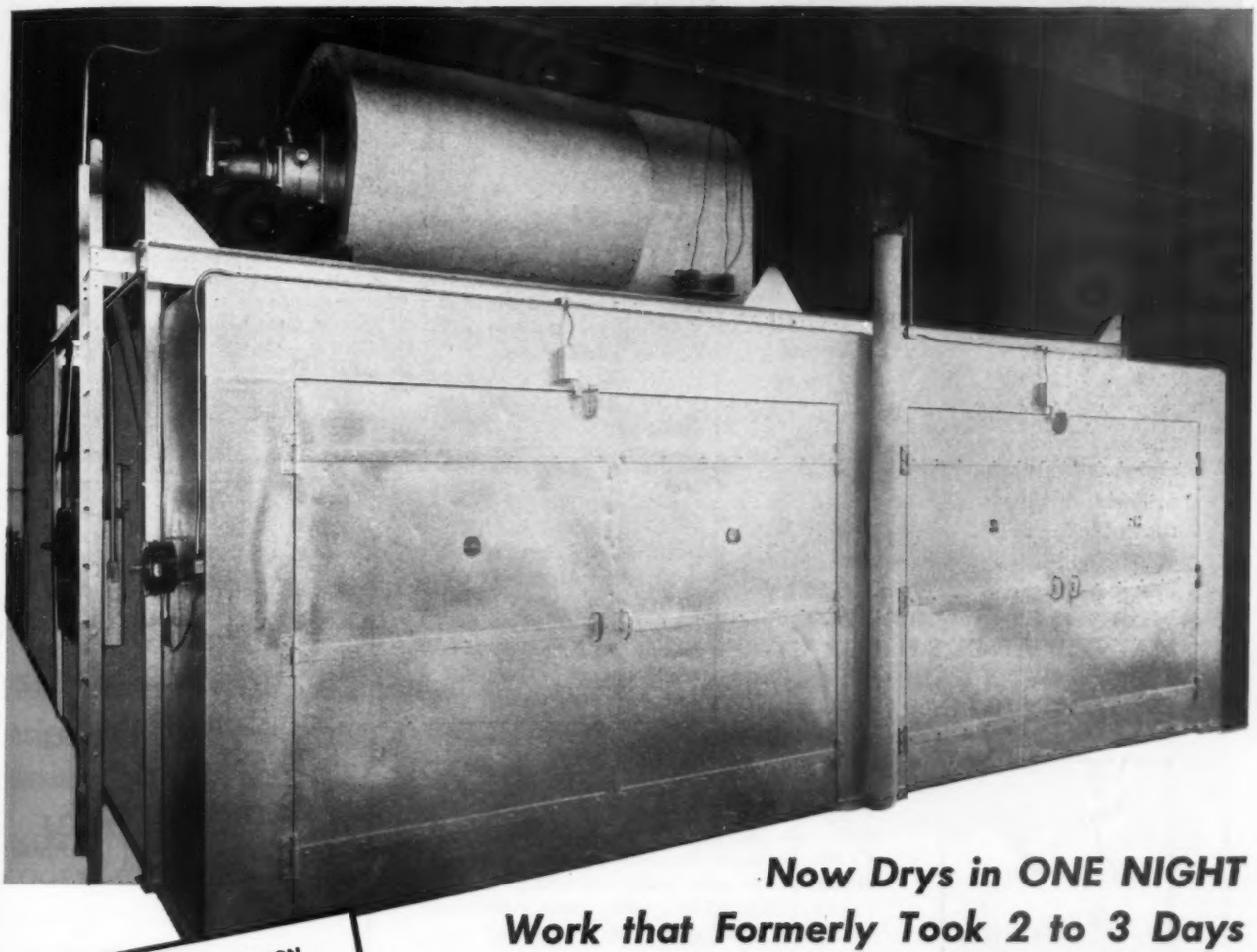
Barrels on Wheels Eliminate Waits

E. H. SCHAEFFER, Industrial Engineer, J. E. Ogden Company, Bayonne, N. J.

By fastening three swivel casters on the bottom of each handling barrel in our die casting room, we have cut down on the time and effort required for parts movement, and increased production from machine operators.

The barrels are steel drums, 18 inches

This CORE *baking* OVEN



Now Drys in ONE NIGHT
Work that Formerly Took 2 to 3 Days

DETAILS OF INSTALLATION

The Core Baking Oven, pictured above, is a 2-compartment design, equipped with a gas fired single heating unit of sufficient capacity to operate the oven at any temperature up to 500°. Compartments may be operated independently or in unison. Trucks, running on rails embedded in cement floor, carry work in and out of the oven through full-opening doors to each compartment. Automatic safety controls prevent premature firing. Control cabinet is attached to side of oven while heating equipment, fans and motors are mounted compactly above, out of the way. Thoroughly insulated throughout. Capacity, 40 tons per charge.

Typical of Mahon engineering ingenuity in the building of productive industrial ovens, is the Core Baking Oven illustrated and described herewith—an installation that is doing a remarkable job for a large Illinois manufacturer. Carrying a load of 40 tons, this oven actually drys in ONE NIGHT the same volume of work that previously required two or three days to turn out—*and the cores come out bone dry.* It is vital to your production and pocketbook that YOUR oven requirements be planned and produced to operate with equal effectiveness and economy. Call in a Mahon engineer. You will appreciate the technical knowledge he can bring to bear on your problem—regardless of the kind of oven you need or the job you want it to do. Consultation incurs no obligation.

THE R. C. MAHON COMPANY • DETROIT • CHICAGO

Designers and Manufacturers of Complete Finishing Systems, Metal Cleaning Machines, Rust Proofing Machines, Hydro-Filter Spray Booths, Drying and Baking Ovens, Dust Collectors, Filtered Air Supply Systems and Many Other Units of Special Production Equipment.

MAHON

SAVE TIME—REDUCE A MAJOR WORRY

1. Dixon's Ticonderoga Flake Lubricating Graphite is unaffected by heat, pressure, solvents, excess moisture. Lubricates where other lubricants fail. Mixed with oils and greases it lends added lubricating and endurance qualities. THAT MEANS ANY GIVEN LUBRICATING JOB NEED BE DONE LESS OFTEN.

2. Alone or in mixture, this pure, natural flake graphite impregnates wearing surfaces with a durable, microscopically thin lubricating film that often prevents costly, schedule-wrecking damage when periodical lubrication is neglected. THAT MEANS LESS WORRY ABOUT MAINTENANCE SUPERVISION, LESS FEAR OF PRODUCTION INTERRUPTIONS.

DIXON'S TICONDEROGA FLAKE LUBRICATING GRAPHITE—Particle Size No. 1—large, lubricous flakes. Particle Size No. 2—finely subdivided, powdered flakes.

DIXON'S NO. 635—Minutely subdivided particle size for close tolerances.

DIXON'S MICROFYNE POWDERED GRAPHITE—Microscopically subdivided particle size for mixing with oils and greases, also "shot" through handy Dixon's Graph-Air Guns for dry lubrication of locks, small tools, etc. Can't drip, gum, nor collect dust.

DIXON'S GRAPH-AIR GUNS

are ideal for lubrication of locks, small tools, etc. A squeeze shoots MICROFYNE Powdered Graphite, which cannot drip, freeze or gum, straight to sources of friction. "CUB", 200 shots, 10¢. "JUNIOR", 900 shots, 30¢. "SENIOR", giant-size rubber refillable model, 75¢ filled.

DIXON'S CUP AND PRESSURE GUN GRAPHITED GREASE

is available in six consistencies, each maintained over an unusually wide temperature range.

DIXON'S L&P (LUBRICATING AND PENETRATING) GRAPHITED OIL

quickly frees rust-frozen bolts and other threaded assemblies, lubricates and prevents future corrosion.

GRAPHITE EXCELLENCE SINCE 1827

JOSEPH DIXON CRUCIBLE CO.
Jersey City, New Jersey

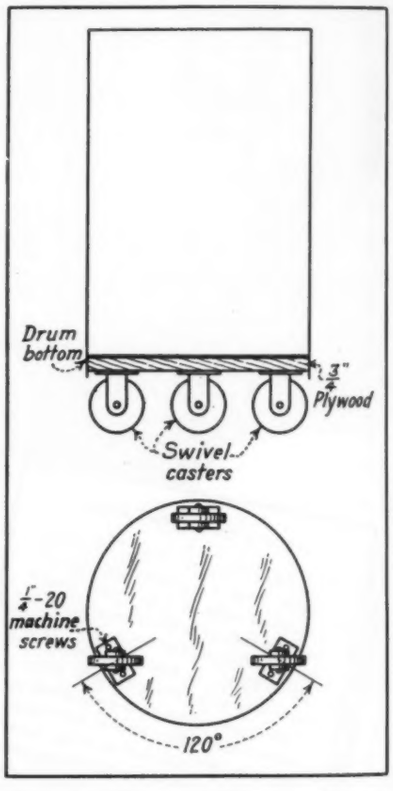
648

in diameter and 30 inches high, with one end open, and are used for transferring and storing gated castings between the die casting machines and trimming presses. A barrel full of castings weighs about 200 pounds. About ten barrels a day are produced by each casting machine. Individual castings weigh about one-half pound each, and average 6x4½ inches.

Due to difference in operating speeds a considerable storage bank of parts is required between die casting machines and presses. Therefore, a conveyor for moving individual castings would be impractical.

Before the wheels were thought of, the barrels were used in conjunction with a hand truck. A study of this handling revealed that 65 percent of the handling man's time was spent in looking for or getting the truck, and loading and unloading the barrel on and off the truck. In many cases expensive machine operators were forced to wait, and in cases where two or more machines required handling attention at once considerable time was wasted.

With the new set-up, these faults are entirely eliminated. If the handling man

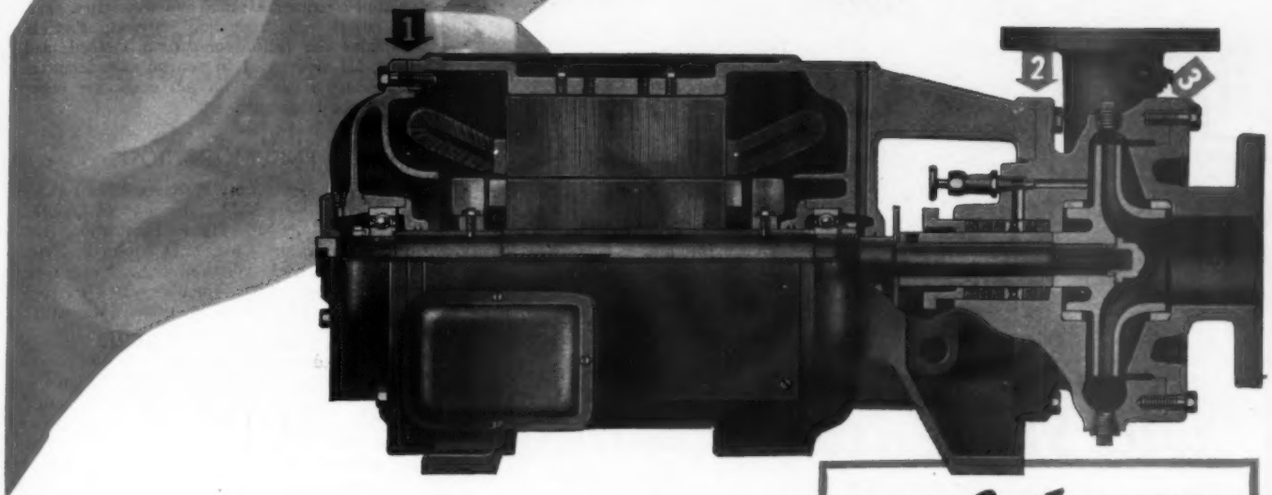


happens to be busy on one machine and a second machine requires some parts handling, it takes only a few seconds for the operator to push the full barrel away and position an empty.

Three-quarter-inch plywood cut into a circle the size of the drum base is used to spread the load and prevent the casters from pushing through the steel bottom. The cost of each caster installation, including plywood, three casters, and labor, is about one dollar. A barrel lift (an idea from a recent issue of FACTORY) is used to empty castings from the wheeled drums onto the feed table of the press.

THREE SECTION-FITS

Make Engineering News!



Allis-Chalmers Electrifugal Pump Offers Exclusive "Tri-Fit" Design with One Piece Casting for Motor, Pump and Bearing Housing, Pump Bracket and Feet . . . Cuts Costs Up To 33%!

ANOTHER ENGINEERING SCOOP for Allis-Chalmers! A new, compact pump unit that offers you these outstanding improvements...

Unified "Tri-Fit" construction guarantees more positive alignment of the single shaft, less wear and tear . . . smoother running, vibration-free operation.

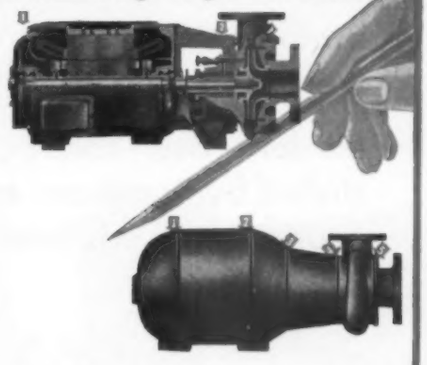
A new motor. . . 100% designed for pump drive and *completely splash-proof* . . . gives far more efficient power.

One-piece frame saves as much as 33% in space . . . 40% in overhang! Indestructible rotor and distortionless stator provide low maintenance and trouble-free service. Cast bronze protective sleeves, splash-proof ventilation and cast aluminum fans are other features that make this revolutionary pump such a great achievement in design and construction!

Best of all . . . *it cuts your costs up to 33% over conventional pump installations.*

For the money-saving details on this new "One Package" Pump . . . call the engineer in the district office near you. Or write Allis-Chalmers, Milwaukee, Wis. for Bulletin B-6140. A-1443

MAKE THIS 3 TO 5 TEST YOURSELF



The NEW Allis-Chalmers Electrifugal Pump has only three section-fits compared to five or more for old style pumps! That means more perfect alignment of the shaft . . . less vibration . . . less wear . . . less trouble. Here's a pump that gives you more gallons . . . for less cost!

Allis-Chalmers Pumps Can Cut Your Pumping Costs

ALLIS-CHALMERS
MILWAUKEE · WISCONSIN

There's NO TIME!
FOR WASTE and BREAKDOWNS

Pangborn Dust Control will STOP costly sabotage

There is no excuse today for waste or breakdowns caused by the destructive wear and tear of DUST.

Modern dust control, as successfully installed by Pangborn engineers, safely and economically rids your plant of the dangers of dust.

Dust is trapped at its very source. It is exhausted into collectors, where it is held for disposal if worthless—or salvaged if it has "raw product" commercial value.

If you wish to conserve valuable time—and provide better sanitary working conditions in your plant—"come to Pangborn" with your large or small dust problems.

PANGBORN

The World's Largest Manufacturer of Dust Control and Blast Cleaning Equipment

HAGERSTOWN - - - - - MARYLAND

BOOKS

MANUAL OF JOB EVALUATION

Eugene J. Benge, management engineer, Samuel L. H. Burk, chief job analyst, The Atlantic Refining Co., Edward N. Hay, personnel officer, The Pennsylvania Company. Harper & Bros., 49 E. 23rd St., New York. 198 pages. Tables, forms, charts. $3.

Devoted to exposition of job analysis and to the method of job evaluation known as "factor comparison." Addressed to executives and workers seeking a practical method for determination of equitable salary and wage rates. Part I covers job evaluation systems; Part II explains the factor comparison method; and Part III is devoted to general considerations, including a chapter on job evaluation under collective bargaining.

PNEUMOCONIOSIS

(Silicosis—the Story of Dusty Lungs) Lewis Gregory Cole, M.D., director of silicotic research, John B. Pierce Foundation, and William Gregory Cole, M.D. John B. Pierce Foundation, 40 W. 40th St., New York. Sent without charge when requested on company letterhead, with the title of the writer.

Highly technical study of silicosis for physicians and research workers. In five parts—"Introduction," "Dust Flecks and Their Carriers," "Four Types of Pneumoconiosis," "Roentgenology," "Social and Economic Aspects," and an appendix with reprints from *Radiology* and *Journal of American Medical Association*.

EMPLOYMENT TESTS FOR INDUSTRIAL WORKERS

Industrial Relations Section, Department of Economics and Social Institutions, Princeton University, Princeton, N. J. Mimeographed bibliography, No. 25 in series. 17 pages. 25c.

Includes lists of books and articles, with brief descriptions, on general discussions of employment tests, principles and procedures, descriptions of specific types of tests and experience in the use of tests.

LABOR POLICY AND NATIONAL DEFENSE

Z. Clark Dickinson, professor of economics, University of Michigan. Bureau of Industrial Relations, University of Michigan, Ann Arbor. Lithoprinted. 62 pages. 75c.

In three major parts, plus a summary. Section A describes mobilization, demobilization, and labor, 1914-1921; Section B is devoted to effect of present war upon foreign labor and labor policies; and Section C sets forth current trends in American wage and labor policy.

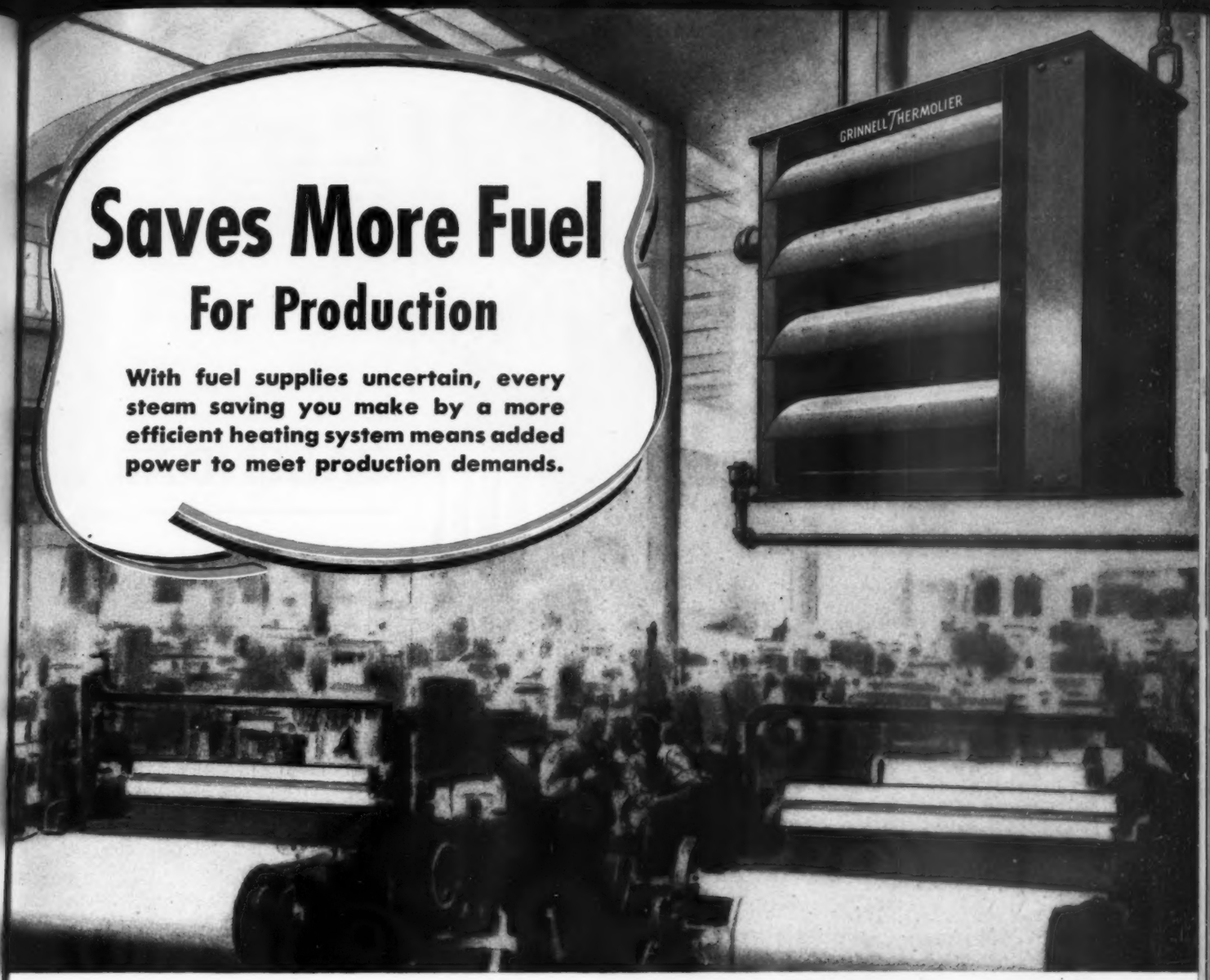
ADDRESSES ON INDUSTRIAL RELATIONS, 1941

Bulletin No. 13, Bureau of Industrial Relations, University of Michigan, Ann Arbor. Mimeographed. 93 pages. $1.

Summaries of addresses by executives of middle-western companies delivered at conference devoted to discussion of problems in the field of employer-employee relations.

MECHANICAL ENGINEERS' HANDBOOK

Lionel S. Marks, editor, Gordon McKay professor of mechanical engineering, emeritus, Harvard University. McGraw-Hill Publishing



Saves More Fuel
For Production

With fuel supplies uncertain, every steam saving you make by a more efficient heating system means added power to meet production demands.

Thermoliers Conserve Fuel
Deliver More Useful Heat

Unit heaters are *heat producing* machines and should be purchased on the same basis as any production machine . . . by heat output, fuel economy, minimum maintenance, length of service.

When measured by this impartial yardstick, Grinnell Thermoliers take top place in effective, economical, service-free heating. Several construction features evolved by Grinnell Engineers from their 50 years of specialized heating experience account for this superiority. Ask any heating engineer about the advantages of these features.

Don't continue to waste fuel in inefficient heating systems; make every pound of steam deliver more heat. Grinnell Thermoliers will do it. Write for complete Data Book. Grinnell Company, Inc., Executive Offices, Providence, Rhode Island. Branch offices in principal cities.

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2 *U-Shaped Tubes* and "condenser type" *tube-to-header construction* eliminates leakage, expansion strains and maintenance.

3 Positive *Built-in Drainage* . . . every tube is pitched for complete drainage of sluggish condensate.

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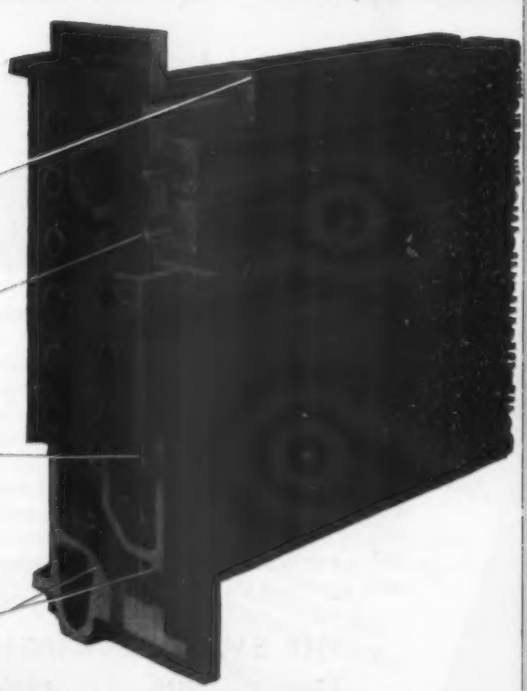

GRINNELL THERMOLIER

THE UNIT HEATER WITH 14 POINTS OF SUPERIORITY

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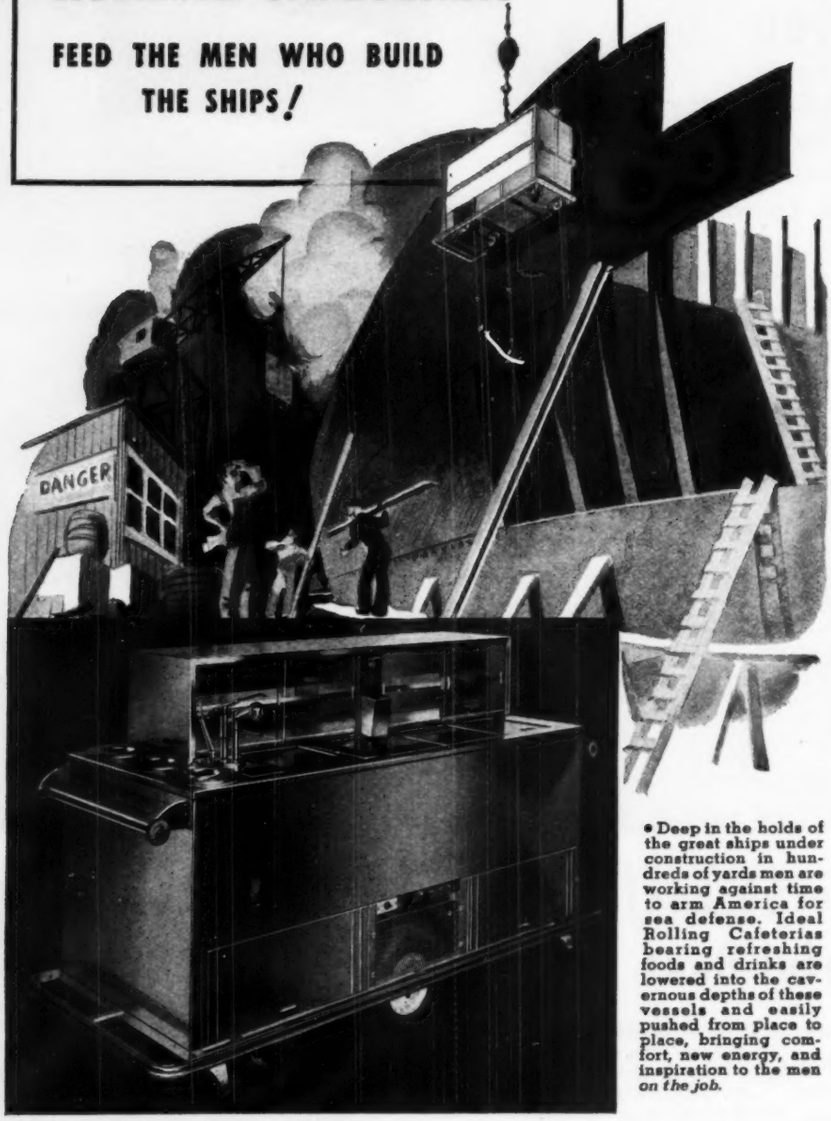
FEED THE MEN WHO BUILD THE SHIPS!



• Deep in the holds of the great ships under construction in hundreds of yards men are working against time to arm America for sea defense. Ideal Rolling Cafeterias bearing refreshing foods and drinks are lowered into the cavernous depths of these vessels and easily pushed from place to place, bringing comfort, new energy, and inspiration to the men *on the job.*

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Co., 330 W. 42nd St., New York. 2,274 pages. Tables, forms, charts, index. $7.

Fourth edition, fully revised and brought up to date. Provides the answers to almost any question on mathematics, mechanics of solids and liquids, heat, strength of materials, materials of engineering, fuel and furnaces, hoisting and conveying, building construction and equipment, electrical engineering, and many other subjects.

•

ON THE CALENDAR

OCTOBER

6–8, National Electrical Contractors Association, Annual Meeting, Houston, Texas. Laurence W. Davis, Secretary, 420 Lexington Ave., New York.

6–10, National Safety Council, Annual Meeting, Chicago. W. H. Cameron, Managing Director and Secretary, 20 North Wacker Drive, Chicago.

6–11, Chicago Exposition of Power and Mechanical Engineering, Quadrennial Meeting, Chicago. Charles F. Roth, Manager, Grand Central Palace, New York.

12–15, American Society of Mechanical Engineers, Fall Meeting, Louisville, Ky. Ernest Hartford, Executive Assistant Secretary, 29 West 39th St., New York.

19–24, American Welding Society, National Metal Exposition, Annual Meeting, Philadelphia. Miss M. M. Kelly, Secretary, 33 West 39th St., New York.

20–22, American Gas Association, Annual Meeting, Atlantic City. Kurwin R. Boyes, Secretary, 420 Lexington Ave., New York.

20–24, American Society for Metals Exposition, Annual Meeting, Philadelphia. W. H. Eisenman, Secretary, 7301 Euclid Ave., Cleveland.

NOVEMBER

12–13, Industrial Hygiene Foundation of America, Inc., Sixth Annual Meeting, Pittsburgh. John F. McMahon, Executive Secretary, 4400 Fifth Ave., Pittsburgh.

19–20, American Management Association, Production Division, Pittsburgh. H. J. Howlett, Secretary, 330 West 42nd St., New. York.

28–29, American Leather Belting Association, Annual Meeting, Atlanta. E. R. Rath, Executive Manager, 53 Park Row, New York.

DECEMBER

1–6, Exposition of Chemical Industries, Biennial Meeting, New York. Charles F. Roth, Manager, Grand Central Palace, New York.

3–5, National Association of Manufacturers, Annual Meeting, New York. Noel Sargent, Secretary, 14 West 49th St., New York.

MILLER LIGHTING for Defense

MORE THAN 100 MILES of IVANHOE "50 & 100 FOOT CANDLERS" are today speeding defense by providing better working light — in armories, arsenals, airplane and parts plants, in the factories of direct defense suppliers. Every single feature of this *guaranteed* and *proven* fluorescent lighting system makes direct, immediate contribution to the defense effort.

★ ***HIGHER ILLUMINATION***—50 to 100 foot candles—for faster, better production —greater worker efficiency.

★ ***30 TO 50% LOWER INSTALLATION COSTS***—Fixtures contain up to 80% of necessary conduit—makes defense dollars go further.

★ ***FASTER INSTALLATION***—Steps up building schedules — plants get into production quicker.

★ ***UNIFORM LIGHT DISTRIBUTION***—Production equipment can be moved at any time without necessity for changing lighting.

★ ***SIMPLIFIED MAINTENANCE***—Easy to clean, removable porcelain-enameled reflectors —saves valuable man-hours for production.

★ ***ALLOWANCE FOR FUTURE LIGHTING NEEDS***—Illumination increases up to 45% practical without new fixtures—low obsolescence factor.

With the need for night work growing still greater . . . with the heat on for faster and faster delivery of defense goods, IVANHOE "50 & 100 FOOT CANDLERS" become more than ever valuable defense weapons. If you, too, are serving for defense, perhaps we can help you.

The Miller Company, now serving for defense, stands ready to serve still further.

MILLER DEFENSE INSTALLATIONS

MILLER-IVANHOE "50 & 100 FOOT CANDLER" installations represent a "roll call" for defense. Here are a few of the many:

Springfield Armory
Frankford Arsenal
Curtiss-Wright Corp.
Grumman Aircraft
Republic Aviation Corp.
Fairchild Aviation
Liberty Aircraft Products
Uxbridge Worsted Co.
Sperry Gyroscope Co.
Ranger Engineering Corp.
United American Bosch
Murray Body Corp.
Pratt and Whitney

PRESIDENT TO ASK NEW ARMS FUNDS; MORE NIGHT WORK

From N. Y. Times Sept. 2nd

★★★★★★

IVANHOE
"50 FOOT CANDLER"
"100 FOOT CANDLER"
RLM Continuous Wireway FLUORESCENT LIGHTING SYSTEM

THE MILLER COMPANY

MERIDEN, CONN.

Pioneers in Good Lighting Since 1844

You can see this guaranteed and proven Fluorescent Lighting System at the Fluorescent Patterns visiting 10 leading cities.

• MILLER OFFERS A COMPLETE LINE of incandescent and fluorescent lighting equipment, backed by almost 100 years of commercial and industrial lighting specialization. There is an answer to your problems in this unbiased lighting service.

Drive this SABOTEUR
Out Of Your Plant!
—and Replace Your
ALUMINUM PAINT
Requirements with

LIGHT GRAY TOTRUST

This Valuable Contribution to Industry In The Present Emergency

STOPS RUST AT ITS SOURCE!

The one and only difference between TOTRUST and our former TOTALUME Aluminum Paint—not to be again available until the present shortage of aluminum is relieved—is in the *pigment;* the *vehicle* is the same. This vehicle—used in our LIGHT GRAY TOTRUST as well as in TOTRUST of all other colors—is a unique binder which *penetrates* into pinholes and rusted pits in metals—*expels moisture*—surrounds and completely *isolates* rust-particles—forms a *hard film* that remains *flexible* through a wide temperature-range.

You need no expensive sand-blasting before painting! You can *safely* apply TOTRUST over *damp metal*—even over *solid rust!* Remember—TOTRUST is *not* an *"ersatz"* makeshift! *It is a top-efficiency rust-preventive paint in its own right*—used for years by many leading industrial plants!

Check these Features of Light Gray Totrust:

1. **Resembles Aluminum Paint**
2. **Has approximately same Light-Reflection**
3. **Paints safely over Solid Rust**
4. **Costs about 2/3 as much as Aluminum**
5. **Paints right over Damp or Galvanized Metal**
6. **Has no odor to penetrate Food Products**
7. **Eliminates most surface-preparation-costs**
8. **Covers 800-1200 sq. ft. per gallon.**

TOTRUST is available in the following colors: Light Gray, Machine Gray, White, Gloss Black, Red, Olive Green

For MONEY-MAKING Facts, *Mail the Coupon NOW!*

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Please send us detailed information on LIGHT GRAY TOTRUST for (please check): .... 8-hour air-drying; .... 4-hour air-drying; .... baking; .... 2-minute drying.

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THEY SAY AND DO

NAM Starts Survey on Health, Safety

Foreseeing a new peak in defense production next spring, the National Association of Manufacturers has launched a survey to help employers prepare for heavier demands on plant health and safety facilities.

On the desks of 8,000 member managements are copies of a four-page check list entitled "How Do We Rate?" This was sent out by the Association's Committee on Healthful Working Conditions of which Ernest Muehleck is chairman. The check list, as its title suggests, provides management with a yardstick of recommended health and safety practices.

The standards on which the list is based were arrived at in a joint study conducted by health experts and plant operating men. The checking points are listed under four headings, each of which is given a percentage ranking in importance and value. The four classifications and their relative ratings are: Employee health and safety control, 35; factory hygiene control, 35; records, 20; health education, 10.

By comparing his own program, point by point, with those recommended in the booklet, the individual can determine the relative effectiveness of his present health and safety facilities. Thus NAM, in effect, has set in motion a nation-wide survey self-conducted by the managements of 8,000 plants.

•

RCA Posters Speed Work on Defense

The 20,000 employees of the RCA Manufacturing Company are working hard these days to "Beat the Promise," and get the company's defense orders out ahead of schedule.

A series of vivid posters are displayed in the five plants of the company at Camden and Harrison, N. J., Indianapolis and Bloomington, Ind., and Hollywood, Calif. The posters are intended, according to the company announcement, "to encourage clear thinking and continued steady production through an avoidance of hampering influences."

In addition to the posters illustrated on this page, other examples depict USA and RCA "linked together for safety and defense," while one employs the Morse Code symbol of "V" for victory as a principal visual attraction.

•

Wage Increases Exceed Living Cost Rise

Despite recent sharp rises in many items of living expense, the pay check of the average industrial wage earner is still well ahead of the cost of living.

Since the start of the war abroad, the Cost of Living Index compiled by the Labor Department's Bureau of Labor Statistics, has risen but 7.5 percent while average weekly earnings in the manufacturing industries have increased 32 percent. Retail food prices, up 10 percent since last March, account for most of the boost in living costs which now are at their highest level in 10 years. The increase in industrial wages is, of course, not uniform, but is fairly general and is particularly prevalent in the durable goods industries where heavy defense orders have been placed.

This trend is an apparent reversal of World War economic history. In 1914-16, living costs increased 14 percent. Wage records were not kept at the time, but it is generally agreed that they failed to keep pace with this upturn. Government economists make no attempt to explain the reversed order of upward movement in the present period. Many observers hold that labor has been in a position to make and enforce its wage demands.

Growing alarm among economists became manifest when the recent pick-up in

WHEREVER *ATMOSPHERE* IS A FACTOR FOR **PROFIT**

YOU NEED **KATHABAR** TO...

ELIMINATE CHILL — SHOCK — CLAMMINESS *for*

● Three great fields are served by Kathabar Systems. In plants and offices where comfort atmospheres are needed to maintain highest efficiency of workers, Kathabar gives you 100% results in atmosphere control. Where industrial processes depend on humidity conditions, Kathabar assures perfect processing atmospheres the year 'round. And in large public buildings for 100% comfort atmospheres. *Turn to Kathabar* to *accurately* control humidity independent of temperature... to *eliminate chill, shock and clamminess!* Backed by America's oldest and largest producers of automatic gas-fired heating and industrial furnace equipment.

A FEW KATHABAR USERS: **Libbey-Owens-Ford Glass Co., Gelatin Products Co., Armour & Co., Universal Match Co., Remington Rand Co., La Choy Food Products, International Nickel Co., U. S. War Building, Palmer House, Curtiss Propeller Division, and many others.**

WHAT IS KATHABAR?

Kathabar is a unit for *completely* controlling humidity in ANY air conditioning system... the equipment that dehumidifies and humidifies 100% *accurately*. Can be installed in your present system to eliminate *chill, shock* and *clamminess*... or as part of any system you are now considering.

SEND FOR FACTS!

SURFACE COMBUSTION CORPORATION
Toledo, Ohio

I'm interested in 100% RESULTS in Atmosphere Control. Without obligation, please send sample specifications and capacities about Kathabar for uses checked:

- ☐ for Industrial Atmospheres in large manufacturing plants
- ☐ for Processing Atmospheres in manufacturing plants
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*Name*_____

*Company*_____

*Address*_____

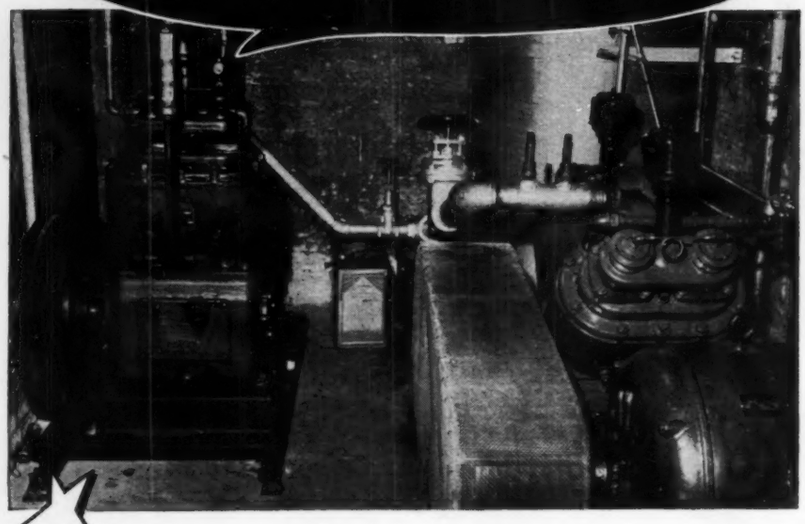
*City*_____ *State*_____

FM10

(SC) KATHABAR

SYSTEM OF HUMIDITY CONTROL FOR COMFORT OR *PROCESSING ATMOSPHERES!*

Manufacturer Buys 4th CURTIS AIR COMPRESSOR



Because of Record of Efficiency and Low Maintenance Costs

The Dowst Manufacturing Company, Chicago, bought its first Curtis Air Compressor in 1921. This original machine operated constantly, 24 hours a day, six days a week, for *fifteen years, with only one minor repair being required.* And this repair was admittedly due to neglect.

As a result, this company has since purchased three additional Curtis compressors—the selection being based upon the unusually efficient performance record of previous Curtis equipment.

This is another example of the dependable, trouble-free performance of Curtis Air Compressors, proven by the operating records of thousands of installations throughout the country.

With Curtis Compressors you can benefit in two ways — by replacing your present overloaded, outworn equipment and by extending the use of air power in your plant. Curtis Compressors are available in capacities up to 360 cfm.

Curtis efficiency and record of minimum maintenance expense is the result of such design features as Timken Roller Bearings, Carbon-free Disc Valves, Centro-Ring Oiling, Automatic Pressure Unloader, and precision workmanship throughout.

● *Write for free 28-page booklet, "How Air Is Being Used in Your Industry," and complete information on Curtis air operated equipment.*

CURTIS

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New York
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CURTIS PNEUMATIC MACHINERY DIVISION
OF CURTIS MANUFACTURING COMPANY
1995 Kienlen Avenue, St. Louis, Mo.

Please send me booklet, "How Air Is Being Used in Your Industry"

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City.....

prices continued unabated while labor sought to move the wage level still higher. From Dr. Leo Wolman, Columbia University Professor of Economics, a friendly critic whose word has carried weight with labor in the past, came the warning that the future wage policy of the unions "may well determine whether the price of things people buy will remain reasonably stable or rise so high as to precipitate a disastrous tumble of prices when defense production tapers off."

"We see here the beginning of the familiar spiral, against which we have been so long forewarned," Wolman said. "Already, more and more groups of employees are citing the rise in living costs as a reason for further increases in wages. When the movement becomes general, inflation of prices will have ceased to be a threat."

Another sharp warning against the spiral was issued by Bernard M. Baruch, World War industrial mobilizer, who testified before the House Banking and Currency Committee in Washington. Baruch demanded a fixed ceiling on prices, wages, and rents. This, he said, is essential both to avert inflation and to win the war.

Baruch termed price, wage, and rent fixing on a blanket basis "the greatest single necessity of our present crisis." He criticized the piecemeal method of price control proposed in the Administration's pending price control bill.

Although 62 percent of public opinion favors price control legislation with wage control features, according to a Gallup survey, such legislation will meet with vigorous opposition in Congress. There the pressure of interested opposition groups will be heavily felt.

Great Britain, which many economists believe to be on the brink of inflation, has so far been unsuccessful in its attempts to include wage stabilization as part of its price-fixing program. Canada, however, has keyed wages to prices by ruling that a proportional increase in wages shall be mandatory only when an equal increase in the Cost of Living Index occurs.

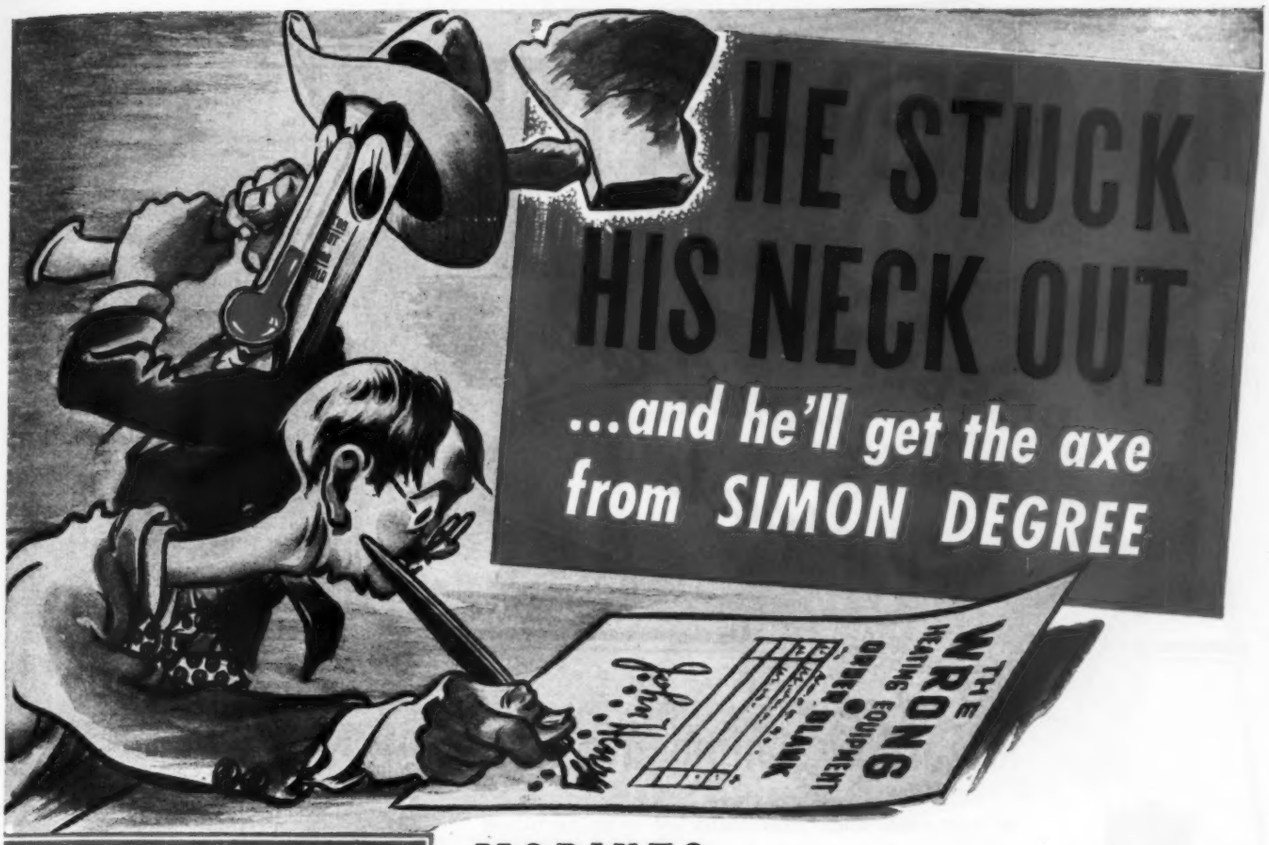
●

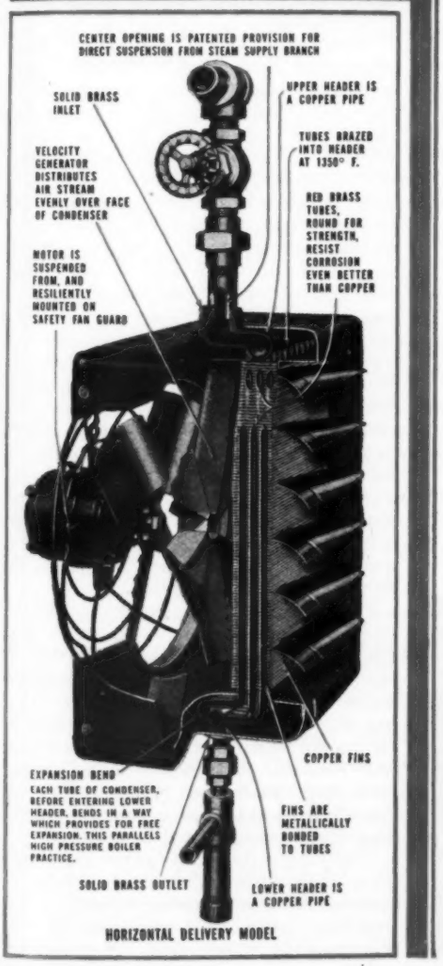
Defense Metals Savings Made by Telephone System

Long-range planning, substitutions, and redesign are credited by the Bell Telephone System with a prospective saving this year of 5,000,000 pounds of metals vitally needed for defense.

Aluminum is now being replaced by steel in the finger-wheels of dial telephones manufactured by the Western Electric subsidiary of the Bell System. Where possible, aluminum is being replaced in many other items of telephone equipment, resulting in a total saving in this metal alone of sufficient aluminum to build 275 fighting airplanes.

By combined substitutions, conservation, reclamation, and simplification of design, the Bell System expects to effect the following reductions in its use of metals this year: aluminum 1,670,000 pounds instead of 2,500,000 pounds; nickel 1,932,000 pounds instead of 2,170,000 pounds; zinc 13,620,000 pounds instead of 17,000,000 pounds; and magne-

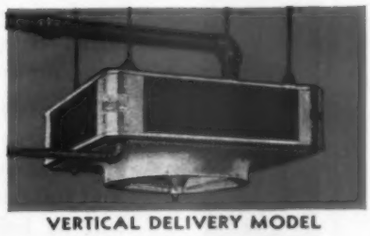



CENTER OPENING IS PATENTED PROVISION FOR DIRECT SUSPENSION FROM STEAM SUPPLY BRANCH
SOLID BRASS INLET
UPPER HEADER IS A COPPER PIPE
VELOCITY GENERATOR DISTRIBUTES AIR STREAM EVENLY OVER FACE OF CONDENSER
TUBES BRAZED INTO HEADER AT 1350° F.
RED BRASS TUBES, ROUND FOR STRENGTH, RESIST CORROSION EVEN BETTER THAN COPPER
MOTOR IS SUSPENDED FROM, AND RESILIENTLY MOUNTED ON SAFETY FAN GUARD
COPPER FINS
EXPANSION BEND
EACH TUBE OF CONDENSER, BEFORE ENTERING LOWER HEADER, BENDS IN A WAY WHICH PROVIDES FOR FREE EXPANSION. THIS PARALLELS HIGH PRESSURE BOILER PRACTICE.
FINS ARE METALLICALLY BONDED TO TUBES
SOLID BRASS OUTLET
LOWER HEADER IS A COPPER PIPE
HORIZONTAL DELIVERY MODEL

MODINES WOULD HAVE SAVED HIM!

This is the short story of a short-sighted man. It will have a sad ending—for *him*. When he bought his heating equipment "at a price" *he stuck his neck out*. And Simon Degree will *get* him—eventually, if not now. Simon Degree is inefficient, insufficient heating and all the high operation and maintenance costs that go with heating equipment built to meet price rather than quality standards.

Forward looking executives and engineers don't make such a mistake. They *specify Modine* Unit Heaters! They know that Modine's fast, automatic heating will be both effective *and economical* now and years from now. And Modines cost little, if any more in the beginning. In the long run, they *always cost less*.


VERTICAL DELIVERY MODEL

When you buy Modine, you are *investing* some of today's profits to insure production and profits tomorrow. Modine leadership . . . Modine recognized reputation for sound design and engineering . . . Modine top quality materials . . . Modine heating performance *proved* in thousands of installations—these are your safeguards.

And Modine expanded facilities and speedier production mean delivery as prompt as any in the industry. *Write for catalog.*

MODINE MANUFACTURING COMPANY, 1730 Racine Street, Racine, Wis.

modine

THE UNIT HEATER THAT IS FASTER AND EASIER TO INSTALL

Look in your phone book for Modine representative's name—"Where to Buy It" section under Heating Apparatus.

AN OPEN LETTER

To ROEBLING *Customers and Prospects*

Regarding Shipments . . .

In common with practically all manufacturers whose products are vital to Defense, Roebling is faced with a situation without precedent.

Despite our best efforts—the expansion of our working force—the installation of new machinery—and operation on a 24-hour basis—we find it impossible to keep up with the demand for Roebling electrical wires and cables.

We want you to know, however, that we keenly appreciate your problem. As a buyer, ourselves, we know how serious and irritating shipping delays can be at a time such as this.

Unfortunately, the pressure is increasing instead of decreasing. But we are alert to every opportunity to effect improvements. And you can rest assured that no stone will be left unturned by Roebling in its efforts to meet your needs.

ROEBLING 1841 1941 100th ANNIVERSARY

JOHN A. ROEBLING'S SONS COMPANY
TRENTON, NEW JERSEY

ROEBLING
ELECTRICAL
WIRES AND CABLES

sium only 2,100 pounds instead of 10,500 pounds.

The Bell reclamation unit, the Nassau Smelting & Refining Company, last year recovered more than 42,000,000 pounds of metal from supplies and equipment junked by the system. Not quite so much scrapped material may be available for reclamation this year, however, since telephone companies throughout the country are continuing the use of much old equipment that normally would be replaced. Dial installations are being deferred in many instances. Used switchboards are being reconditioned, and cables are being re-sheathed and re-used.

•

Government Costs Tripled Since 1913, Study Shows

Independent tax analysis agencies, their zeal undimmed by defense developments, still continue their ceaseless attack on the "soaring costs of government."

Public attention to a serious contrast between the nation's fiscal position at the start of the World War and that of today, is called in a new publication of the Tax Foundation, entitled "Tax Facts and Figures." This 80-page study reveals that the cost of government, federal, state, and local, consumed 27.5 percent of the national income in 1940 against 8 percent in 1913.

Defense costs, the Foundation points out, "must be piled on an already burdened economy."

"Before the World War, the federal government alone owed $1,000,000," the booklet declares. "Today it owes more than $50,000,000 and the debt in the near future is already estimated at $100,000,000 or $4,000 for every single family in the country."

By thus emphasizing the rising costs of government, it is expected that the Foundation's new publication, which will be issued annually, will help to stress the need for reduction of non-defense governmental expenditures. Another organization which has vigorously attacked governmental extravagance is the National Economy League which recently accused the federal government of failure to curtail its non-defense construction activities in proportion to the requirements of the defense program.

The League cited the allocation to the Rural Electrification Administration of 4,500 tons of copper per month and lesser quantities of steel, zinc, and aluminum, as an example of its contention.

"The same materials allocated to industries which have long used them for essential parts would probably forestall a significant amount of 'priority unemployment,'" the League declared. "The closing of a factory on which workers depend for employment in established occupations and localities, is a much more serious dislocation than the postponement of those rural electrification projects which have merely been started or proposed."

The League described further appropriations for the Rural Electrification Administration as "a direct public subsidy to the benefited groups." It also pointed out the apparent inconsistency of extending

"WE HAVE FOUND A SAVING OF 5000 CU. FT. OF GAS PER HOUR..."

WRITES ARKANSAS PLANT SUPERINTENDENT ABOUT FANMIX GAS BURNER

Another COPPUS BLUE RIBBON *Product*

A superintendent of a large Arkansas Plant writes about the FANMIX Gas Burner: "We have found that our production has been equivalent to, or a little better than, previous production with a saving of 5000 cu. ft. of gas per hour which is approximately 13.5%."

There are twelve exclusive advantages in the Coppus-Dennis Fanmix Gas Burner — which result not only in considerable savings, as reported in the testimonial above, but also in lower installation costs and also in higher ratings through perfect gas-air ratio and complete instantaneous combustion.

An entirely new method of driving the fan and simultaneously mixing gas and air in automatically controlled ratio, results in the greater simplicity and efficiency of this Burner. It will be well worth your while to study this new operating principle and its twelve benefits to you.

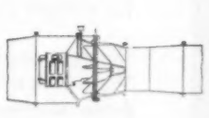
Write today for free FANMIX Bulletin.

Coppus Engineering Corporation, 213 Park Avenue, Worcester, Mass. Sales Offices in THOMAS' REGISTER; other "Blue Ribbon" products in SWEET'S.

BLUE RIBBON
Sign of Precision Manufacture

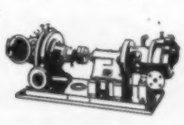
On every Coppus product is a Blue Ribbon so that customers can easily see it is a product made under rigid controls of manufacture and inspection. See listing of other Coppus Products in this ad.

COPPUS BLUE RIBBON PRODUCTS
Designed for your Industry
Engineered for You



COPPUS VANO BLOWERS. 1001 uses. High efficiency on special installations where ordinary fans fail. Bulletin 115-6.

COPPUS BOILER MANHOLE BLOWERS AND EXHAUSTERS. For cooling of boilers, drums, etc. Bulletin 161-3.

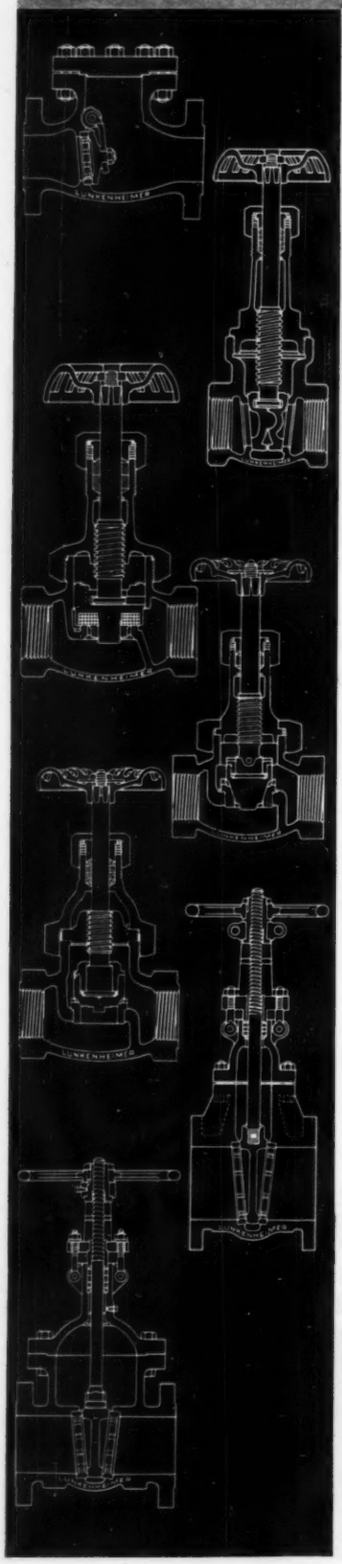


COPPUS STEAM TURBINES. For small H.P. jobs—six sizes, (and prices) from 150 H.P. down to fractional. Steam — Gas — or compressed Air driven. Bulletin 135-9.

COPPUS HEAT KILLERS. Keep production up by keeping men cool. Also for furnaces, motors, generators, etc. Bulletin 160-4.

COPPUS

LUNKENHEIMER VALVES



Perform important service functions in support of Defense Operations

It's quite natural when thinking of Defense to picture large plants—thousands of machines—and legions of men all busily engaged in the production of munitions, tanks, armored tractors, ships, airplanes and similar war units.

Let's peek behind the scenes at the Power Plants, furnishing the energy for all this defense work. Here, where countless valves control the power that keeps these factories humming, lies a distinct responsibility for maintaining uninterrupted production. Here the selection of the correct valve for the job takes on new values—stamina to stand up over long periods without failure—simplicity of design that insures ease of repair — pretested construction that insures constant service without frequent replacement.

Correctly engineered, rugged Lunkenheimer Valves are a "natural" for this important defense service. The accurate machining of vital parts eliminates excessive wear—reduces maintenance — provides longer operating life — insures continuous satisfactory service—all distinct aids in maintaining high production in hard-pressed plants.

Thus, in serving industry *better*, Lunkenheimer is helping to conserve both power and materials in the "all out" production for defense needs, and you're helping too, when you use Lunkenheimer Valves.

Your Lunkenheimer distributor is cooperating in every way to give you the kind of service you so vitally need for the National Defense Program. His facilities will save you time and trouble.

ESTABLISHED 1862
THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI, OHIO, U. S. A.
NEW YORK CHICAGO
BOSTON PHILADELPHIA
EXPORT DEPT. 318-322 HUDSON ST., NEW YORK

the use of electrical power at a time when the manufacture of household electrical appliances was being curtailed.

•

Industry's Cooperation Praised by FBI Chief

J. Edgar Hoover, Chief of the Federal Bureau of Investigation, is warm in his praise of the manner in which industrial management has supported the national fight against sabotage.

Reporting that 1,700 out of 2,428 key defense plants have been surveyed by the FBI, Hoover declared in an article in the *American Foreign Service Journal*, a semi-official State Department publication, that industry had cooperated in the survey "magnificently."

"Though making any change as a result of the (FBI's) recommendation is entirely optional with the plant management," he continued, "industrial concerns have responded gladly and have gone to great lengths to improve their plant protection activities."

Hoover disclosed that in one powder plant 30,000 employees were fingerprinted and it was found that 3,000 had some sort of criminal record.

•

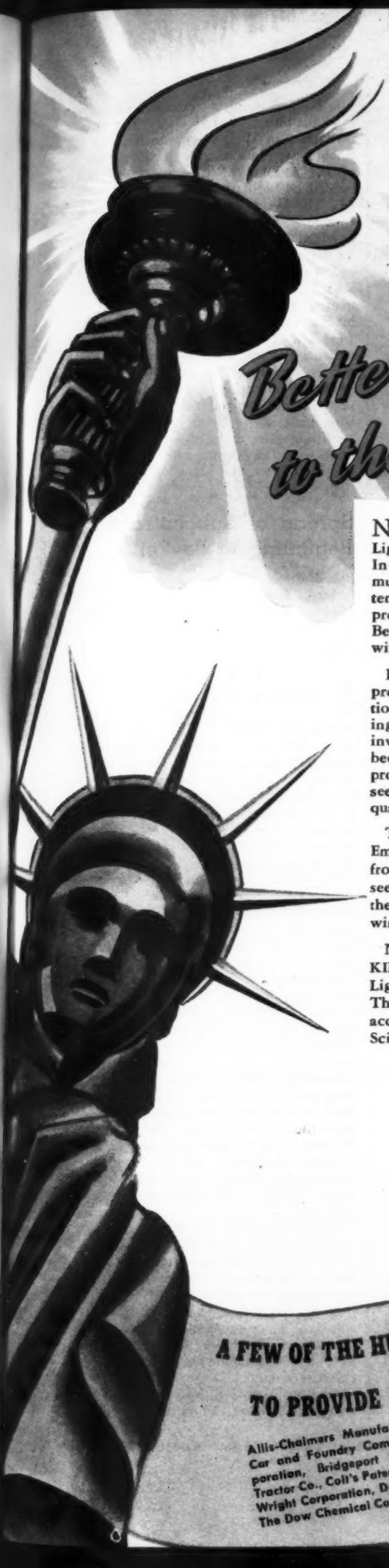
One Hundred Years of Free Enterprise

One hundred years of uninterrupted manufacturing in America! There's a record that is seldom enough attained in this country, where the business mortality rate is inclined to be high.

On September 19, 1941, John A. Roebling and Sons, Roebling, N. J., celebrated its 100th birthday. Not only has this company been in existence since 1841, it has also been under the direction of the same family since its beginning. Today, three of the founder's great-grandsons carry on the tradition of family management inaugurated back in 1841.

John A. Roebling, born in Germany in 1806, emigrated to the United States in 1831, with his brother and a small group of young people. As an engineer for the State of Pennsylvania, connected with the Pennsylvania Canal project, he saw the need for improvement in the manner of transporting barges across the mountains by portage railways. Large hempen ropes, 9 inches in diameter, were being used to tow the boats up the hills. To replace these ropes, which were cumbersome and expensive, John A. Roebling made the first wire rope to be sold in America. Thus was started the firm that today occupies 417 acres of plant space, carries on its payroll over 6,200 names, and makes all kinds of wire rope, wire, cables, woven wire fabrics, bare round and shaped wires, flat wire—and whose product is found in most of the important bridges in America.

Four wars have punctuated the growth of the Roebling Company: (1) The Civil War, when one of the founder's sons, Washington A. Roebling was commissioned a colonel in the engineering forces of the Union Army, and achieved distinction by erecting several strategic suspen-



To Increase Production
To Conserve Manpower
To Prevent Material Waste

Better Lighting is Vital to the Defense Program!

NEVER before has industry's need for Better Lighting been so vital to the nation's welfare! In ship yards, aircraft factories, naval bases and munitions plants... in the daily growing list of tens of thousands of plants devoted to Defense production... American workers must be given Better Lighting to see faster and easier and work with greater speed, accuracy and less fatigue.

Better Lighting is vital to this effort. For, as proven by scientific tests and in actual operation, Good Lighting increases the speed of seeing and conserves energy. Objects and defects invisible to the average eye under poor light become easily visible when enough light is provided. Thus, good lighting makes it easy to see fine details and improves the quality and quantity of production.

The basis of Better Lighting is MORE LIGHT. Employees engaged in Defense Production need from 35 to 75 footcandles of light for good seeing and sustained production effort. Even these high levels are less than workers near windows usually receive on clear summer days.

Not only MORE LIGHT but also the RIGHT KIND OF LIGHTING is involved in Better Lighting as provided by Benjamin Equipment. The lighting equipment must be designed in accordance with established principles of the Science of Illumination to insure the even distribution of light over the working surface; to provide light that is soft and diffused; to minimize reflected glare; to shield adequately the lamps so that the eyes are protected from fatiguing glare.

Naturally Benjamin's first duty is to satisfy the Better Lighting requirements of Defense Projects so that uniform seeing efficiency may prevail in every department, for all employees, at every time of day and night.

In fulfilling this duty, Benjamin is taxing every resource to provide the fluorescent lighting equipment... the incandescent and mercury lighting units... the explosion proof and vapor proof units... the floodlighting equipment... so essential to the Better Lighting required by National Defense.

But Benjamin is cognizant, too, of the existing need for Better Lighting to conserve the eyesight of workers in all industries. To the extent that materials are available, Benjamin will make every effort to continue to serve those industries, which, while not directly engaged in Defense production, nevertheless, contribute to the common objectives of our nation.

In developing lighting plans, consult the data and specifications shown in Benjamin Catalog No. 26. Benjamin Electric Mfg. Co., Dept. N, Des Plaines, Illinois.

BENJAMIN TRADE MARK

WORLD LEADER IN INDUSTRIAL

LIGHTING EQUIPMENT

DISTRIBUTED EXCLUSIVELY THROUGH ELECTRICAL WHOLESALERS

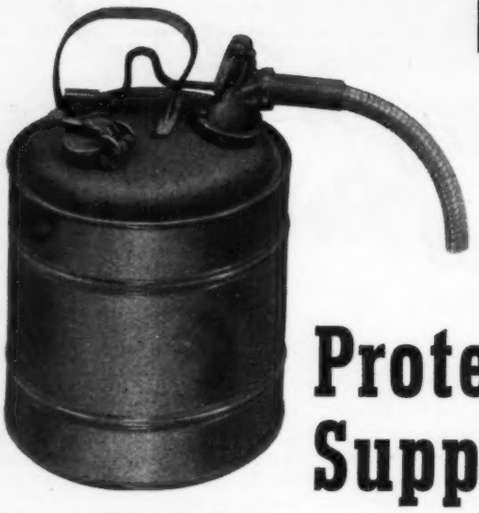
A FEW OF THE HUNDREDS OF DEFENSE PROJECTS LIGHTED BY BENJAMIN

TO PROVIDE *Keener Eyes for the Eagle!*

Allis-Chalmers Manufacturing Company, American Car and Foundry Company, Bendix Aviation Corporation, Bridgeport Brass Company, Caterpillar Tractor Co., Colt's Patent Fire Arms Mfg. Co., Curtiss-Wright Corporation, Douglas Aircraft Company, Inc., The Dow Chemical Company, Electric Boat Company, Hercules Powder Company, Kingsbury Ordnance Plant, Lockheed Aircraft Corporation, The Glenn L. Martin Co., North American Aviation, Inc., Ravenna Ordnance Plant, Remington Arms Company, Inc., St. Louis Ordnance Plant, Vultee Aircraft, Inc., Winchester Repeating Arms Company.

Safe

THE ~~CONVENIENT~~ WAY TO HANDLE FLAMMABLE LIQUIDS



Protectoseal Supply Cans

Avoid waste, spillage and evaporation losses, and reduce fire hazards by dispensing volatile, flammable liquids from these convenient containers. Balanced and easy to handle . . . fast pouring (or slow) with automatic closure of fill and vent openings. Workmen prefer these Supply Cans because they save time and bother.

Flexible Spout eliminates funnels—pours without spilling.

Manually-Controlled Valve precisely regulates the flow of liquid.

Double Perforated Baffles positively prevent ignition of can's contents.

Balanced Handle for easy carrying and dispensing.

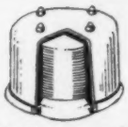
Heavy Terne Plate construction, double seamed and soldered, with bottom reinforcing rim. Built to stand hard wear and abuse.

Fully Approved by Underwriters' Laboratories and Factory Associated Mutuals. In 3 and 5 gallon sizes with rigid or flexible spouts.

PROTECTOSEAL DRUM FITTINGS ASSURE SAFETY IN THE STORAGE OF FLAMMABLE LIQUIDS

No. 500 Bung Fitting is a combination fill and vent. It provides pressure and vacuum relief, and prevents drum rupture in case of fire.

No. 502 Automatic Faucet, with reducer and removable screen, protects the drum contents while dispensing flammable liquids.



No. 671 Protectoseal Vents prevent flashbacks into the tank. Easily inspected and cleaned—may be used with corrosive vapors.

No. 522 Bung Fitting is recommended for dead drum storage, or for live storage where bung need not be removed for refilling purposes.

Write for complete catalog of Protectoseal Equipment for handling, storing and dispensing inflammable liquids safely

Square Wash Tank for cleaning small parts in flammable liquids by immersing removable dip basket.

Bench Can with perforated metal dasher flame baffle for cleaning and scrubbing. Minimizes evaporation losses!

PROTECTOSEAL COMPANY OF AMERICA, INC.
1920 SOUTH WESTERN AVENUE CHICAGO, ILLINOIS

sion bridges—using considerable wire rope from his father's factory. (2) The Spanish American War, when the facilities of Roebling were called upon to supply many of the varieties of wire rope and wire needed by both the Army and the Navy. (3) The World War. All kinds of wire wire rope, wire netting were needed and provided in the shortest possible time for torpedo nets, submarine nets, aircraft and balloon control cable, and so on Karl G. Roebling was appointed chairman of the committee of control set up by the American Iron and Steel Institute (4) The present war. Production of national defense materials has been stepped up far beyond normal to supply such necessary defense items as harbor defense nets, aircraft control cables, field signal wire, material for tanks, wire rope slings for lifting guns, tanks, shells, bomb demolition wires, Degaussing cable for repelling magnet mines—and many other articles.

•

Spread of Subcontracting Beginning to Be Felt

The drive to rescue non-defense manufacturers from the dilemma of "priority unemployment," has begun to take effect, according to a recent report by the National Association of Manufacturers.

That the situation has eased was indicated by a check-up of small manufacturing companies in 19 key cities. The NAM made its report on the basis of a cross-section study of 189 firms chosen at random from a long list of companies who had reported in an earlier survey, on May 1, that they were without defense contracts. Seventy-five percent of the 189 concerns replied, in the new questionnaire, that they are now managing to remain at least partially in operation on defense work.

While the reports indicate the growing effectiveness of subcontracting, it shows clearly that the job has only begun. Many of the reporting firms indicated that defense work was still but a small part of their volume and that, unless further defense contracts could be obtained, they might have to shut down between 10 and 50 percent of their facilities. Of the 47 reporting firms that are still without defense work of any kind, nine admitted that they were not interested in obtaining subcontracts and six said they were unable to get such contracts because their facilities were not adaptable. These were the leading reasons, the remaining 32 plants giving a variety of miscellaneous answers. A number, however, said they were unable to bid successfully against larger and better-equipped low-cost producers.

Emphasizing the fact that the dislocations of defense were still a major threat to industry, NAM has launched a new nation-wide Priorities Unemployment Survey through its affiliate, the National Industrial Council. The new study is aimed to reveal the exact gravity of the problem in order to provide defense officials at Washington with correct and essential data.

Walter D. Fuller, president of NAM, issued a statement calling upon all manu-

WE RENEW OUR PLEDGE

Two years ago, at the beginning of the present war with its uncertainties and threats to the future of all industry, this Company publicly pledged itself not to increase its selling prices.

On this, the second anniversary, we again publicly renew that pledge.

During the last two years we have not only kept the pledge previously made, but *we have actually reduced our selling prices by more than 6%* because of more efficient operation made possible by the marvelous cooperation and ability of our organization. This was accomplished in the face of rising labor and material costs, both of which have been increased by considerable amounts.

It is our belief that the only hope for the continuance of the present industrial system now threatened from within and without is in its ability to give more and more to the consumer for less and less of his dollar. This is the strength of American individual initiative. This is the hope of our country's future. If American industry can accomplish this universally, we need not fear dictators either at home or abroad.

THE LINCOLN ELECTRIC COMPANY

Cleveland, Ohio
October 2, 1941

J. F. Lincoln
President

DON'T LET WINTER SLOW YOUR PRODUCTION

GET SPECIFICATIONS NOW . . .

ON YOUNG *High Efficiency* HEATING!

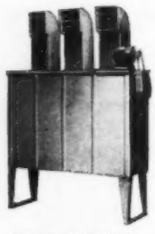
This winter is no time to let cold, drafty, unhealthy working conditions reduce the efficiency of your workmen. It costs less to maintain healthful temperatures in factory, office or warehouse with YOUNG High Efficiency heaters. These practical units are made in many different types and sizes to fit the heating needs of any installation. YOUNG heaters have patented features of construction that assure efficient and economical operation. Catalogs giving complete information and technical data are available for each of the YOUNG units shown below. Refer to your classified phone directory for the name of your local YOUNG representative, or write—

THE YOUNG RADIATOR CO.

Dept. 121-K, Racine, Wisconsin

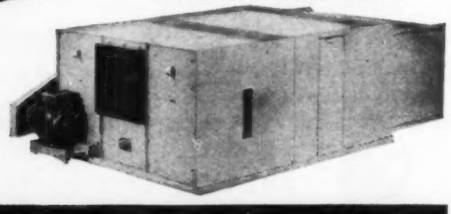
Vertiflow Unit Heater Vertical air discharge Catalog No. 2541.

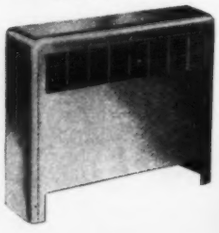
"FH" Unit Heater Catalog No. 336



"SH" Unit Heater Catalog No. 2738

Streamaire Air Conditioning Unit—Horizontal Type 8 sizes—400 to 16,600 C.F.M. Also available in Vertical Type. Catalog No. 7541.





Streamaire Convector Catalog No. 4039

For Our Country's Defense

From the Young Radiator Company plant come heat transfer units to cool the great engines of our army's newest tanks, trucks and war planes. Young unit heaters and convectors heat barracks and defense housing, as well as important new plants, factories, arsenals, offices, etc.

Young *High Efficiency*

HEATING COOLING AND AIR CONDITIONING UNITS

UNIT HEATERS • CONVECTORS • CONDENSERS • EVAPORATORS • AIR CONDITIONING UNITS • HEATING COILS • COOLING COILS

OIL COOLERS • GAS, GASOLINE, DIESEL ENGINE COOLING RADIATORS • INTERCOOLERS • HEAT EXCHANGERS ENGINE JACKET • WATER COOLERS

facturers and state and local trade associations to cooperate in the survey.

"It is estimated that at least half of the 184,000 manufacturing plants in the nation may be hit—some fatally—by the stringency of defense material rationing," Mr. Fuller declared.

"The lack of metals and other strategic materials now being sequestered for national defense, to which we are, as a nation, committed, has thrown out of gear our normal, peace-time production machinery. This we must, and do, accept as the price we must pay for the defense of our American freedoms.

"Nevertheless I appeal to you to show the same patriotism in helping solve what may be a tragic problem for millions of workers by assisting in this survey of non-defense plants in order that we may provide the essential information needed by Washington to relieve the situation and save jobs."

•

Electrical Engineers' Handbook in Seventh Edition

One hundred and two experts in their fields contributed to the making of the Seventh Edition of "Standard Handbook for Electrical Engineers," edited by A. E. Knowlton, and recently published by McGraw-Hill Book Company.

Divided into 26 sections, each thumb-tabbed for quick and easy reference, the book contains a total of 2,303 pages, including a comprehensive index.

It is eight years since a new edition of this work, which first appeared in December, 1907, has been prepared. Many changes in the order of importance of the recognized branches of the electrical art have taken place, and many new provinces of activities have appeared. Material in the seventh edition has been regrouped in recognition of these changes.

According to the preface the book is designed, to be "primarily an encyclopedia of applicable information and secondarily an epitome of the academics of electrical phenomena."

•

Nelson Urges Reduction in Styles of Goods

A ceaseless campaigner for simplifying design of non-defense goods is Donald M. Nelson, national priorities director.

Nelson, who before the defense program called him to Washington was vice-president of Sears, Roebuck, seldom misses an opportunity to preach this doctrine. He has said, in the past, that the unit production of the general run of consumer goods might be increased as much as 30 percent by the elimination of "frills and trimmings."

"Every retailer," he declared at a recent meeting of the National Retail Dry Goods Association, "knows that he does most of his business on a small part of his stock. If he could carry fewer styles and sizes of things—fewer styles of shoes, fewer styles of washing machines, fewer styles of overcoats and dresses and kitchen utensils and vacuum cleaners—he would be better off, provided that the elimina-

Guard the VITAL governor zone—

SMALLER CLEARANCES of the governor parts in modern turbines *demand* a turbine oil that will prevent *rust.* And because that same oil must adequately lubricate bearings, gears and flexible couplings to guard against costly shutdowns, it should also have *superior oxidation stability . . . minimum foaming tendencies.* The new Shell Turbo Oil is the first to meet *all 3* of these requirements.

Call in the Shell man today and let him give you the *facts* about this revolutionary new turbine oil. You'll find his recommendations entirely practical—and made without obligation.

—with the turbine oil that prevents rust

SHELL TURBO OIL

SHELL

KRANE KAR SWING BOOM TRACTOR CRANE

3 SIZES:
2½, 5, & 10 ton capacities

8 Points for Defense

1. VISION is unobstructed
2. BOOM TOPPING with *full* load
3. STABILITY *without* stabilizers
4. TRACTION INCREASED with load
5. AUTOMATIC BRAKES
6. EASY STEERING with load
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Send for Bulletin 55, with illustrations and specifications

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Stool No. E-1824 Adjustable from 18 to 24 inches.

You'll like the trim lines of Kewaunee Ever-Hold Stools and Chairs—the absence of all set screws and gadgets. There are no projections to tear hose or clothing. But the big extra value they offer is invisible. It's a "3rd Comfort" Feature—"Height that's Right" for every worker always.

EVER-HOLD TRADE MARK
Automatic-Adjustable Stools & Chairs

have concealed inside the seat post a positive self locking device that never fails and never gets out of order. Simply lifting the seat locks it instantly at exact comfort height for the user.

Write for Free Catalog and Prices on all models of Stools and Chairs for Office and Factory use.

Kewaunee Mfg. Co. LABORATORY FURNITURE EXPERTS
C. G. Campbell, *President*
5026 S. Center St., Adrian, Mich.
Leaders in the Manufacture of Laboratory Furniture Since 1905

tion of the abandoned styles was performed wisely with the best interests of consumer, retailer, manufacturer, and national economy in mind.

"Nor would the consumer feel any particular hardship. After all, we are not exactly asking the American people to bear a great load if we ask them to select their winter blankets from among half a dozen styles and colors, instead of from 30 or 40. No one suffers much if he has only four new car styles to choose between instead of having a dozen—provided that the cars which are offered are just as good."

One small industry moved, meanwhile, to make its policies conform to Mr. Nelson's views. The Bicycle Manufacturers Association of America launched the first industry-wide program to reduce the number of models, designs, and materials. The campaign began with a letter sent out to manufacturers by the Association under the signature of Robert E. McConnell, OPM Conservation Section chief.

"Although the program is voluntary," said H. M. Meloney, executive secretary of the Association, "we feel it has teeth in it, and of course the industry is anxious to cooperate."

Upon receipt of the letter, manufacturers were reported to be preparing for elimination of non-essential materials from new bicycle models as well as the simplification of design. They will then present to Washington a list of materials they believe to be essential, as a guide to future priority ratings. With further reductions in automobile output, the bicycle makers believe not only that they may receive good preference ratings but also that their production may eventually rise to 400 percent above last year's record total of 1,325,000 units. Heavyweight motor bikes, however, will not be produced hereafter.

•

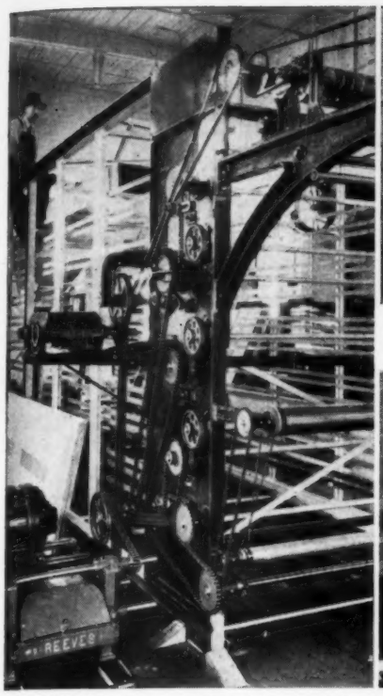
Deferment Trends Noted in Draft Study

The occupational future of large groups of Americans has become fairly well defined in recent months by the practical applications of the Selective Service Act as clarified by decisions of the draft administration.

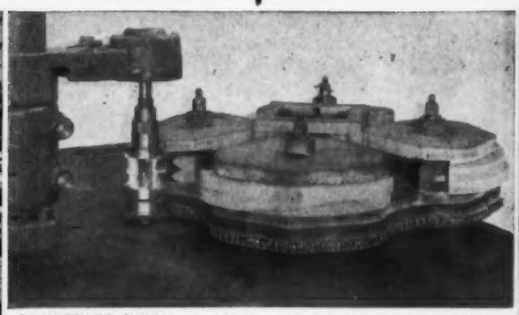
It was naturally expected, for example, that skilled machinists directly engaged in defense manufacture would certainly be deferred. Now it has become evident that the demands of defense will overtax the nation's supply of engineers and physicians as well. So serious is the possibility of a national shortage of technically trained men that National Selective Service Headquarters has recommended the deferment not only of graduates, but also of students of civil, electrical, chemical, mechanical, and mining and metallurgical engineering. Soon afterwards a special memorandum was issued to state directors, recommending that local draft boards give thought to the need for providing an uninterrupted supply of doctors and urging that special consideration be given to internes and qualified medical students.

"A generally similar position is taken with regard to dentists and dental students,

TYPICAL RECENT APPLICATIONS OF ROLLER CHAIN BELTS BY SMART ENGINEERS

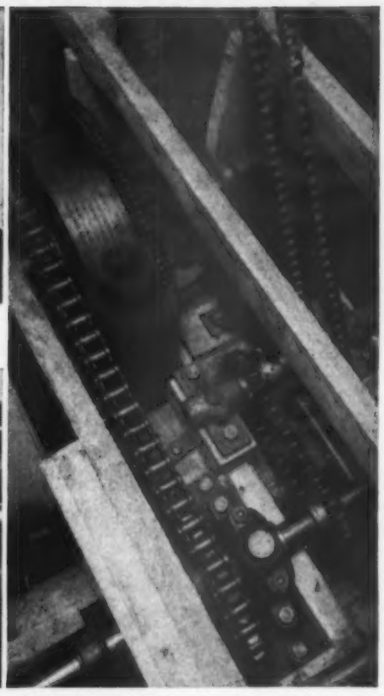


YOU CAN DO *almost anything with roller chain belts: witness this maze of drives on a continuous shrinking machine in the textile industry.*



SOMETHING NEW! *A guide that will never stray is formed by a roller chain belt templet developed for greater speed and accuracy in cutting out wood shapes.*

SPLIT-SECOND TIMING *of Baldwin roller chain belt makes this metal-working machine "tops" for consistent, high-speed production.*



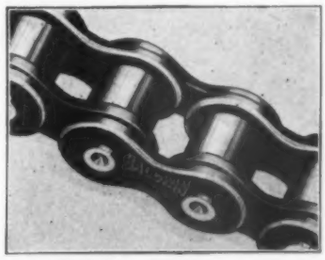
SHORT CENTERS, *long centers, high speeds and low speeds—roller chain belts handle all these drives at 98.6% efficiency.*

ARE YOU USING ROLLER CHAIN BELTS *for all they're Worth?*

● *Are you finding it difficult to keep up with the production parade today? Are you face to face with the demand—"speed up—or else"? If you are, you've a lot of company! Production men everywhere are trying to increase plant capacity without "going overboard" on costs.*

These men are finding roller chain belts to be mighty useful. They're often surprised to see the improvements brought forth when roller chain belts replace an old gear drive here—when complicated belting gives way to compact, 98.6% efficient *roller chain belting:* or when an old way of lifting, lowering and moving products through the plant is replaced by smooth, steady, reliable roller chain belt conveyors.

Actually there are very few tools of production quite so broadly useful, so downright inexpensive and easy to use, as are roller chain belts. That's why we say, don't overlook Baldwin roller chain belts, today—or at any time!



ONLY ROLLER CHAIN BELTS COMBINE
constantly efficient operation
with
indefinitely long life
with
shock-absorbing ability
with
resistance to dust and dirt
with
ability to operate on short centers

BALDWIN
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Whether in relation to a defense problem or a commercial application, your inquiry will receive prompt attention. However, delivery of Baldwin products for the latter must be subordinate to the delivery of orders bearing priority distinction.

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and also veterinary doctors and students," says Harold F. Browne, of the Management Research Division of the National Industrial Conference Board in a report on "Trends in Occupational Deferment" in the Conference Board *Management Record*. Mr. Browne also points to other recent rulings of the Selective Service Administration which hold considerable significance for industrial executives.

"One of these is that employee registrants who have been deferred because they are 'necessary men' immediately lose this status when they leave their jobs, and therefore must be reclassified," he says. "This general principle has been in force from the beginning, but it acquired special pertinency when it was invoked in connection with the strike at the North American Aviation Corporation. Obviously, if men deferred because they are indispensable in defense work abandon that work for a longer or shorter period, because of strikes, they are no longer performing defense work and reclassification is in order.

"The second ruling provides automatic deferment for the registrant who became 28 years of age on or after July 1, 1941. For many reasons it was found that the younger registrant could most satisfactorily be inducted for military training and, pending specific Congressional authorization, the Deputy Director of Selective Service sent out on July 2 instructions to induct no more men 28 years of age or over, pending enactment of further legislation on the subject by Congress. This ruling will automatically assure the continued service in industry of the older and usually more highly skilled men who registered originally for the jobs. Of course, it will correspondingly increase the proportion of younger men who will be called for service."

•

Industrial Truck Bookings Slightly Lower in August

August bookings for electric industrial trucks were a little lower than those for July, figures compiled by the Industrial Truck Statistical Association indicate. There were 227 units booked during August and 273 units in July.

There were 30 non-elevating platform trucks, with capacities and chassis base prices ranging from 3,000 to 6,000 lb., and $1,700 to $4,935, respectively; 155 cantilever trucks, capacities and chassis base prices ranging from 1,000 to 20,000 lb., and $1,900 to $9,500, respectively, had a total net value at factories of $594,037.25; 13 tractors, both light and heavy duty, chassis base prices ranging from $1,450 to $3,020 had a total net value at factories of $21,755; 10 crane trucks, capacities and chassis base prices ranging from 3,000 at 7-ft. radius to 10,000 lb., and $5,280 to $8,150, respectively, had a total net value at factories of $62,508; and one 2,000-lb. special scoop shovel truck has a total net value at factory of $3,960. All net values are at factories after additions and deductions for variation from standard specifications, trade-in-allowances, etc. Also included are adjustments for cancellations of 1941 bookings.

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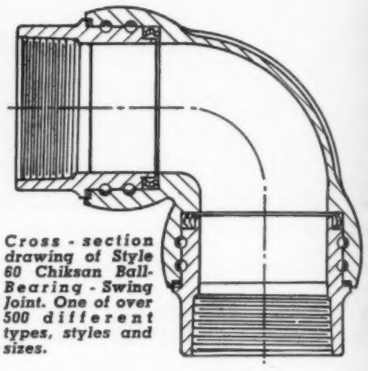

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